GEN2 T-A® Recommended Drilling Data | Metric (mm)

HSS Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min TiN	M/min AM200®	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	Feed Rate (mm/rev) by Diameter 12.98 - 17.52
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	61	99	0.20	0.30
		150 - 200	50 - 70	500-700	HSS	55	91	0.18	0.28
		200 - 250	70 - 88	700-870	HSS	49	85	0.15	0.25
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	HSS	52	88	0.20 ❖	0.25
		125 - 175	46 - 62	450 - 600	HSS	49	83	0.18 ❖	0.25
		175 - 225	62 - 77	600 - 775	HSS	46	79	0.15 ❖	0.23
		225 - 275	77 - 96	775 - 940	HSS	43	73	0.13 ❖	0.23
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	49	83	0.18	0.25
		175 - 225	62 - 77	600 - 775	HSS	46	79	0.15	0.23
		225 - 275	77 - 96	775 - 940	HSS	43	73	0.15	0.23
		275 - 325	96 - 111	940 - 1090	C1	40	68	0.13	0.20
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	46	73	0.18	0.25
		175 - 225	62 - 77	600 - 775	HSS	43	68	0.15	0.23
		225 - 275	77 - 96	775 - 940	HSS	40	64	0.15	0.23
		275 - 325	96 - 111	940 - 1090	C1	37	59	0.13	0.20
		325 - 375	111 - 129	1090 - 1265	C1	34	54	0.10	0.18
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	C1	24	38	0.15 ❖	0.23
		300 - 350	104 - 121	1020 - 1180	C1	18	30	0.13 ❖	0.20
		350 - 400	121 - 139	1180 - 1365	PC	15	24	0.10 ❖	0.18
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	43	71	0.20 ❖	0.28
		150 - 250	50 - 88	500 - 850	HSS	37	57	0.15 ❖	0.25
		250 - 350	88 - 121	850 - 1180	C1	30	48	0.13 ❖	0.23
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	24	38	0.10	0.18
		200 - 250	70 - 88	700 - 870	C1	18	32	0.10	0.18
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC, PC	9	13	0.10 ❖	0.18
		220 - 310	77 - 101	755 - 990	PC	8	12	0.10 ❖	0.15
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC, PC	11	16	0.10 ❖	0.18
		220 - 310	77 - 101	755 - 990	PC	10	15	0.08 ❖	0.15
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC, PC	23	35	0.15 ❖	0.20
		275 - 350	96 -121	940 - 1180	SC, PC	18	31	0.13 ❖	0.18
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC, PC	23	35	0.15 ❖	0.20
		275 - 350	96 - 121	940 - 1180	SC, PC	18	31	0.13 ❖	0.18
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC, PC	23	35	0.08 ❖	0.18
		185 - 275	65 - 96	640 - 940	SC, PC	18	31	0.08 ❖	0.15
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC, PC	18	26	0.08 ❖	0.18
		185 - 275	65 - 96	640 - 940	SC, PC	15	22	0.08 ❖	0.15
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC, PC	14	21	0.08 ❖	0.15
		500	160	1600	PC	10	14	0.05 ❖	0.12
		600	210	2000	N/A	–	–	–	–
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	PC	15	29	0.10 ❖	0.15
		400 - 500	139+	1365+	PC	10	14	0.06 ❖	0.12
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	52	84	0.20	0.30
		150 - 200	50 - 70	500 - 700	HSS	46	79	0.18	0.28
		200 - 220	70 - 77	700 - 755	HSS	40	68	0.15	0.23
		220 - 260	77 - 90	755 - 890	SC, PC	34	57	0.13	0.20
		260 - 320	90 - 104	890 - 1020	SC, PC	27	47	0.13	0.18
N	**Cast Aluminium**	30	10	100	HSS	183	–	0.23	0.38
		180	62	600	HSS	91	–	0.20	0.33
	Wrought Aluminium	30	10	100	HSS	183	280	0.12	0.33
		180	62	600	HSS	91	200	0.12	0.18
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	52	82	0.15	0.24
		200 - 250	68 - 87	670 - 855	SC	40	65	0.12	0.18
	Brass	100	38	370	HSS	91	144	0.18	0.27
	Copper	60	21	200	SC	40	58	0.07 ❖	0.10

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (mm/rev) by Diameter				
17.53 - 24.38	24.41 - 35.00	35.01 - 47.80	47.85 - 65.99	66.00 - 114.48
0.41	0.48	0.51	0.58	0.71
0.38	0.43	0.51	0.58	0.71
0.36	0.41	0.51	0.58	0.71
0.36	0.46	0.48	0.58	0.69
0.36	0.43	0.48	0.58	0.69
0.33	0.41	0.46	0.53	0.61
0.33	0.41	0.46	0.53	0.61
0.36	0.43	0.48	0.58	0.69
0.33	0.41	0.46	0.53	0.61
0.33	0.41	0.46	0.53	0.61
0.30	0.38	0.41	0.48	0.56
0.36	0.43	0.43	0.48	0.56
0.33	0.41	0.43	0.48	0.56
0.33	0.41	0.43	0.48	0.56
0.30	0.38	0.38	0.43	0.51
0.28	0.36	0.38	0.43	0.51
0.28	0.33	0.36	0.43	0.51
0.25	0.30	0.36	0.43	0.51
0.23	0.28	0.30	0.41	0.46
0.38	0.43	0.46	0.53	0.66
0.33	0.38	0.41	0.48	0.61
0.30	0.33	0.36	0.43	0.51
0.25	0.30	0.30	0.38	0.43
0.25	0.30	0.30	0.38	0.43
0.23	0.28	0.30	0.38	–
0.20	0.25	0.25	0.30	–
0.21	0.27	0.30	0.38	–
0.18	0.23	0.25	0.30	–
0.23	0.28	0.36	0.41	0.51
0.20	0.25	0.30	0.36	0.46
0.23	0.28	0.36	0.41	0.51
0.20	0.25	0.30	0.36	0.46
0.20	0.28	0.36	0.41	0.51
0.18	0.25	0.30	0.36	0.46
0.20	0.28	0.36	0.41	0.51
0.18	0.25	0.30	0.36	0.46
0.20	0.23	0.30	0.41	0.46
0.18	0.20	0.25	0.30	0.40
–	–	–	–	–
0.23	0.27	0.30	0.41	0.46
0.18	0.24	0.25	0.30	0.40
0.41	0.51	0.61	0.69	0.76
0.38	0.48	0.56	0.64	0.71
0.33	0.43	0.46	0.53	0.61
0.28	0.36	0.36	0.43	0.51
0.25	0.28	0.28	0.36	0.41
0.46	0.58	0.56	0.64	0.64
0.40	0.50	0.56	0.64	0.64
0.40	0.50	0.56	0.64	0.64
0.30	0.35	0.56	0.64	0.64
0.30	0.38	0.43	0.48	0.53
0.23	0.28	0.36	0.40	0.46
0.33	0.45	0.47	0.53	0.58
0.18	0.26	0.23	0.27	0.31

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

GEN2 T-A® Recommended Drilling Data | Metric (mm)

Carbide Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min AM200®	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	12.98 - 17.53	17.54 - 24.38	24.41 - 35.00
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	C1	146	0.20	0.30	0.41	0.48
		150 - 200	50 - 70	500-700	C1	126	0.18	0.28	0.38	0.43
		200 - 250	70 - 88	700-870	C1	119	0.15	0.25	0.36	0.41
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	C1	137	0.20 ❖	0.25	0.36	0.46
		125 - 175	46 - 62	450 - 600	C1	119	0.18 ❖	0.25	0.36	0.43
		175 - 225	62 - 77	600 - 775	C1	108	0.15 ❖	0.23	0.33	0.41
		225 - 275	77 - 96	775 - 940	C1	95	0.13 ❖	0.23	0.33	0.41
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	C1	119	0.18	0.25	0.36	0.43
		175 - 225	62 - 77	600 - 775	C1	108	0.15	0.23	0.33	0.41
		225 - 275	77 - 96	775 - 940	C1	95	0.15	0.23	0.33	0.41
		275 - 325	96 - 111	940 - 1090	C1	80	0.13	0.20	0.30	0.38
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	C1	115	0.18	0.25	0.36	0.43
		175 - 225	62 - 77	600 - 775	C1	105	0.15	0.23	0.33	0.43
		225 - 275	77 - 96	775 - 940	C1	95	0.15	0.23	0.33	0.41
		275 - 325	96 - 111	940 - 1090	C1	87	0.13	0.20	0.30	0.38
		325 - 375	111 - 129	1090 - 1265	C1	78	0.10	0.18	0.28	0.36
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	C1	70	0.15 ❖	0.23	0.28	0.33
		300 - 350	104 - 121	1020 - 1180	C1	63	0.13 ❖	0.20	0.25	0.30
		350 - 400	121 - 139	1180 - 1365	C1	56	0.10 ❖	0.18	0.23	0.28
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	C1	108	0.20 ❖	0.28	0.38	0.43
		150 - 250	50 - 88	500 - 850	C1	87	0.15 ❖	0.25	0.33	0.38
		250 - 350	88 - 121	850 - 1180	C1	80	0.13 ❖	0.23	0.30	0.33
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	C1	78	0.10	0.18	0.25	0.30
		200 - 250	70 - 88	700 - 870	C1	59	0.10	0.18	0.25	0.30
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	C2	37	0.10 ❖	0.18	0.23	0.28
		220 - 310	77 - 101	755 - 990	C2	29	0.10 ❖	0.15	0.20	0.25
	Titanium Alloy	140 - 220	49 - 77	480 - 755	C2	42	0.10 ❖	0.18	0.21	0.27
		220 - 310	77 - 101	755 - 990	C2	33	0.08 ❖	0.15	0.18	0.23
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	C2	73	0.12 ❖	0.16	0.18	0.22
		275 - 350	96 -121	940 - 1180	C2	56	0.10 ❖	0.14	0.16	0.19
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	C2	73	0.18 ❖	0.23	0.30	0.36
		275 - 350	96 - 121	940 - 1180	C2	56	0.15 ❖	0.20	0.28	0.30
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	C2	73	0.14 ❖	0.18	0.24	0.29
		185 - 275	65 - 96	640 - 940	C2	56	0.12 ❖	0.16	0.22	0.24
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	C2	38	0.12 ❖	0.17	0.22	0.26
		185 - 275	65 - 96	640 - 940	C2	30	0.10 ❖	0.15	0.18	0.22

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min AM200®	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	12.98 - 17.53	17.54 - 24.38	24.41 - 35.00
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	C2	45	0.07 ❖	0.12	0.20	0.25
		500	160	1600	C2	37	0.05 ❖	0.10	0.15	0.20
		600	210	2000	C2	30	0.04 ❖	0.08	0.12	0.16
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	C1	47	0.10 ❖	0.18	0.23	0.27
		400 - 500	139+	1365+	C1	37	0.06 ❖	0.12	0.18	0.24
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	C2	152	0.20	0.30	0.38	0.48
		150 - 200	50 - 70	500 - 700	C2	146	0.18	0.28	0.33	0.43
		200 - 220	70 - 77	700 - 755	C2	131	0.15	0.23	0.30	0.38
		220 - 260	77 - 90	755 - 890	C2	113	0.13	0.20	0.28	0.33
		260 - 320	90 - 104	890 - 1020	C2	102	0.13	0.18	0.25	0.28
N	**Cast Aluminium**	30	10	100	C2	300	0.23	0.38	0.46	0.58
		180	62	600	C2	225	0.20	0.33	0.40	0.50
	Wrought Aluminium	30	10	100	C2	426	0.12	0.33	0.40	0.50
		180	62	600	C2	300	0.12	0.18	0.30	0.35
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	C2	110	0.15	0.24	0.30	0.38
		200 - 250	68 - 87	670 - 855	C2	90	0.12	0.18	0.23	0.28
	Brass	100	38	370	C2	200	0.18	0.27	0.33	0.45
	Copper	60	21	200	C2	130	0.07 ❖	0.10	0.18	0.26

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

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

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

T-A® Original Recommended Drilling Data | Metric (mm)

HSS Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	HSS Grade	M/min TiN	M/min TiAlN	M/min TiCN	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	Feed Rate (mm/rev) by Diameter 12.98 - 17.52
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	61	85	79	0.18	0.25
		150 - 200	50 - 70	500-700	HSS	55	79	72	0.18	0.25
		200 - 250	70 - 88	700-870	HSS	49	73	64	0.15	0.25
	Low Carbon Steel 1010, 1020, 1025, 1522, , 1144, etc.	85 - 125	30 - 46	300-450	HSS	52	76	67	0.15 ❖	0.23
		125 - 175	46 - 62	450 - 600	HSS	49	73	64	0.15 ❖	0.23
		175 - 225	62 - 77	600 - 775	HSS	46	69	59	0.13 ❖	0.20
		225 - 275	77 - 96	775 - 940	HSS	43	64	55	0.13 ❖	0.20
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	49	73	64	0.15	0.23
		175 - 225	62 - 77	600 - 775	HSS	46	69	59	0.13	0.20
		225 - 275	77 - 96	775 - 940	HSS	43	64	55	0.13	0.20
		275 - 325	96 - 111	940 - 1090	SC, PC	40	59	52	0.10	0.18
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	46	64	59	0.15	0.20
		175 - 225	62 - 77	600 - 775	HSS	43	59	55	0.13	0.20
		225 - 275	77 - 96	775 - 940	HSS	40	55	52	0.13	0.18
		275 - 325	96 - 111	940 - 1090	SC, PC	37	52	47	0.10	0.15
		325 - 375	111 - 129	1090 - 1265	SC, PC	34	47	44	0.08	0.15
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	SC, PC	24	34	30	0.13 ❖	0.18
		300 - 350	104 - 121	1020 - 1180	SC, PC	18	26	24	0.10 ❖	0.18
		350 - 400	121 - 139	1180 - 1365	PC	15	21	20	0.08 ❖	0.15
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	43	61	55	0.15 ❖	0.25
		150 - 250	50 - 88	500 - 850	HSS	37	52	47	0.13 ❖	0.23
		250 - 350	88 - 121	850 - 1180	SC, PC	30	43	40	0.10 ❖	0.20
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	24	34	32	0.10	0.15
		200 - 250	70 - 88	700 - 870	SC, PC	18	27	26	0.10	0.15
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC, PC	9	12	11	0.08 ❖	0.18
		220 - 310	77 - 101	755 - 990	PC	8	11	9	0.08 ❖	0.15
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC, PC	11	15	14	0.08 ❖	0.18
		220 - 310	77 - 101	755 - 990	PC	9	14	11	0.08 ❖	0.15
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC, PC	23	32	29	0.15 ❖	0.20
		275 - 350	96 -121	940 - 1180	SC, PC	18	27	24	0.13 ❖	0.18
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC, PC	23	32	29	0.15 ❖	0.20
		275 - 350	96 - 121	940 - 1180	SC, PC	18	27	24	0.13 ❖	0.18
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC, PC	23	32	29	0.08 ❖	0.18
		185 - 275	65 - 96	640 - 940	SC, PC	18	27	24	0.08 ❖	0.15
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC, PC	18	24	21	0.08 ❖	0.18
		185 - 275	65 - 96	640 - 940	SC, PC	15	20	18	0.08 ❖	0.15
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC, PC	14	21	17	0.08 ❖	0.15
		500	160	1600	PC	11	14	12	0.05 ❖	0.13
		600	210	2000	N/A	–	–	–	–	–
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	PC	15	29	21	0.08 ❖	0.15
		400 - 500	139+	1365+	PC	11	14	12	0.05 ❖	0.13
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	52	76	67	0.18	0.30
		150 - 200	50 - 70	500 - 700	HSS	46	69	59	0.15	0.28
		200 - 220	70 - 77	700 - 755	HSS	40	59	52	0.15	0.23
		220 - 260	77 - 90	755 - 890	SC, PC	34	50	44	0.13	0.18
		260 - 320	90 - 104	890 - 1020	SC, PC	27	41	37	0.10	0.15
N	**Cast Aluminium**	30	10	100	HSS	183	259	229	0.20	0.33
		180	62	600	HSS	91	137	122	0.20	0.33
	Wrought Aluminium	30	10	100	HSS	183	259	229	0.10	0.15
		180	62	600	HSS	91	137	122	0.20	0.33
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	52	76	67	0.15	0.28
		200 - 250	68 - 87	670 - 855	SC	40	58	52	0.13	0.18
	Brass	100	38	370	HSS	91	136	122	0.18	0.30
	Copper	60	21	200	SC	40	50	46	0.05 ❖	0.08

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (mm/rev) by Diameter					DW Cutting Data	
17.53 - 24.38	24.41 - 35.00	35.01 - 47.80	47.85 - 65.99	66.00 - 114.48	Speed m/min	Feed (mm/rev)
0.33	0.41	0.51	0.58	0.71	58-76	0.35
0.33	0.41	0.51	0.58	0.71		
0.33	0.41	0.51	0.58	0.71		
0.30	0.38	0.48	0.58	0.69	48-66	0.3
0.30	0.38	0.48	0.58	0.69		
0.25	0.36	0.46	0.53	0.61		
0.25	0.36	0.46	0.53	0.61		
0.30	0.38	0.48	0.58	0.69	48-66	0.3
0.25	0.36	0.46	0.53	0.61		
0.25	0.36	0.46	0.53	0.61		
0.23	0.30	0.41	0.48	0.56		
0.25	0.36	0.43	0.48	0.56	30.36	0.28
0.25	0.36	0.43	0.48	0.56		
0.25	0.36	0.43	0.48	0.56		
0.23	0.30	0.38	0.43	0.51		
0.23	0.30	0.38	0.43	0.51	22-26	0.25
0.23	0.25	0.36	0.43	0.51	16-20	0.25
0.23	0.25	0.36	0.43	0.51		
0.20	0.23	0.30	0.38	0.46		
0.30	0.36	0.46	0.53	0.66	42-54	0.3
0.25	0.30	0.41	0.48	0.61		
0.23	0.25	0.36	0.43	0.51		
0.20	0.25	0.30	0.38	0.43	31-38	0.23
0.20	0.25	0.30	0.38	0.43		
0.20	0.25	0.30	0.38	–	N/A	N/A
0.18	0.20	0.25	0.30	–		
0.20	0.25	0.30	0.38	–		
0.18	0.20	0.25	0.30	–		
0.23	0.25	0.36	0.41	0.51		
0.20	0.20	0.30	0.36	0.46		
0.23	0.25	0.36	0.41	0.51	22-29*	0.23*
0.20	0.20	0.30	0.36	0.46		
0.20	0.25	0.36	0.41	0.51	22-29*	0.23*
0.18	0.20	0.30	0.36	0.46		
0.20	0.25	0.36	0.41	0.51	16-20*	0.23*
0.18	0.20	0.30	0.36	0.46		
0.20	0.23	0.30	0.41	0.46	N/A	N/A
0.18	0.20	0.25	0.30	0.41		
–	–	–	–	–		
0.20	0.23	0.30	0.41	0.46	N/A	N/A
0.18	0.20	0.25	0.30	0.41		
0.41	0.51	0.61	0.69	0.76	53-62	0.3
0.36	0.46	0.56	0.64	0.71		
0.30	0.41	0.46	0.53	0.61		
0.23	0.30	0.36	0.43	0.51		
0.18	0.23	0.30	0.36	0.41		
0.41	0.51	0.56	0.64	0.64	109-146	0.32
0.41	0.46	0.56	0.64	0.64		
0.25	0.30	0.56	0.64	0.64	109-146	0.32
0.41	0.46	0.56	0.64	0.64		
0.36	0.46	0.56	0.66	0.71	35-44	0.3
0.23	0.30	0.36	0.43	0.51		
0.41	0.51	0.61	0.71	0.76	79-99	0.38
0.15	0.20	0.30	0.36	0.41	29-32	0.2

*only applicable up to 120mm

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

T-A® Original Recommended Drilling Data | Metric (mm)

Carbide Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min TiN	M/min TiAlN	M/min TiCN	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	12.98 - 17.52	17.53 - 24.38	24.41 - 35.00	35.01 - 47.80
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	C5	96	128	115	0.20	0.30	0.38	0.45	0.53
		150 - 200	50 - 70	500-700	C5	85	110	100	0.18	0.28	0.35	0.40	0.48
		200 - 250	70 - 88	700-870	C5	79	104	90	0.15	0.25	0.33	0.38	0.43
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	C5	91	119	110	0.20 ❖	0.25	0.33	0.43	0.48
		125 - 175	46 - 62	450 - 600	C5	79	104	90	0.18 ❖	0.25	0.33	0.40	0.45
		175 - 225	62 - 77	600 - 775	C5	73	95	82	0.15 ❖	0.23	0.30	0.38	0.43
		225 - 275	77 - 96	775 - 940	C5	64	83	75	0.13 ❖	0.23	0.30	0.38	0.43
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	C5	79	104	90	0.18	0.25	0.33	0.40	0.45
		175 - 225	62 - 77	600 - 775	C5	73	95	84	0.15	0.23	0.30	0.38	0.43
		225 - 275	77 - 96	775 - 940	C5	67	83	72	0.15	0.23	0.30	0.38	0.43
		275 - 325	96 - 111	940 - 1090	C5	55	70	62	0.13	0.20	0.28	0.35	0.40
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	C5	76	99	87	0.18	0.25	0.33	0.40	0.45
		175 - 225	62 - 77	600 - 775	C5	70	92	80	0.15	0.23	0.30	0.38	0.43
		225 - 275	77 - 96	775 - 940	C5	64	83	72	0.15	0.23	0.30	0.38	0.43
		275 - 325	96 - 111	940 - 1090	C5	61	76	68	0.13	0.20	0.28	0.35	0.40
		325 - 375	111 - 129	1090 - 1265	C5	52	67	60	0.10	0.18	0.25	0.33	0.38
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	C5	49	61	55	0.15 ❖	0.23	0.25	0.30	0.38
		300 - 350	104 - 121	1020 - 1180	C5	43	55	49	0.13 ❖	0.20	0.23	0.28	0.35
		350 - 400	121 - 139	1180 - 1365	C5	37	49	43	0.10 ❖	0.18	0.20	0.25	0.30
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	C5	73	95	84	0.20 ❖	0.28	0.35	0.40	0.45
		150 - 250	50 - 88	500 - 850	C5	61	76	68	0.15 ❖	0.25	0.30	0.35	0.40
		250 - 350	88 - 121	850 - 1180	C5	55	70	62	0.13 ❖	0.23	0.28	0.30	0.35
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	C5	49	67	58	0.10	0.18	0.23	0.28	0.33
		200 - 250	70 - 88	700 - 870	C5	37	52	45	0.10	0.18	0.23	0.28	0.33
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	C2	24	32	28	0.10 ❖	0.18	0.23	0.28	0.33
		220 - 310	77 - 101	755 - 990	C2	18	26	22	0.10 ❖	0.15	0.20	0.25	0.30
	Titanium Alloy	140 - 220	49 - 77	480 - 755	C2	30	38	32	0.10 ❖	0.18	0.23	0.28	0.33
		220 - 310	77 - 101	755 - 990	C2	24	33	28	0.10 ❖	0.15	0.20	0.25	0.30
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	C2	49	64	57	0.17 ❖	0.22	0.29	0.35	0.40
		275 - 350	96 -121	940 - 1180	C2	37	49	43	0.14 ❖	0.19	0.27	0.30	0.35
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	C2	49	64	57	0.17 ❖	0.22	0.29	0.35	0.40
		275 - 350	96 - 121	940 - 1180	C2	37	49	43	0.14 ❖	0.19	0.27	0.30	0.35
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	C2	49	64	57	0.13 ❖	0.17	0.22	0.26	0.30
		185 - 275	65 - 96	640 - 940	C2	37	49	43	0.11 ❖	0.14	0.20	0.22	0.25
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	C2	25	33	29	0.11 ❖	0.15	0.19	0.23	0.27
		185 - 275	65 - 96	640 - 940	C2	19	25	22	0.09 ❖	0.13	0.18	0.20	0.23

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min TiN	M/min TiAlN	M/min TiCN	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	12.98 - 17.52	17.53 - 24.38	24.41 - 35.00	35.01 - 47.80
H	**Wear Plate**	400	139	1365	C5	23	35	30	0.07	0.12	0.20	0.25	0.30
	Hardox, AR400, T-1, etc.	500	160	1600	C5	15	26	21	0.05	0.10	0.15	0.20	0.25
		600	210	2000	C5	11	22	16	0.04	0.08	0.12	0.16	0.20
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	C5	34	43	39	0.10 ❖	0.18	0.23	0.28	0.33
		400 - 500	139+	1365+	C5	20	25	23	0.08 ❖	0.15	0.20	0.23	0.28
K	**Nodular, Grey,**	120 - 150	44 - 50	430 - 500	C2, C3	98	141	127	0.20	0.30	0.38	0.48	0.58
	Ductile Cast Iron	150 - 200	50 - 70	500 - 700	C2, C3	82	122	102	0.18	0.28	0.33	0.43	0.53
		200 - 220	70 - 77	700 - 755	C2, C3	73	110	93	0.15	0.23	0.30	0.38	0.45
		220 - 260	77 - 90	755 - 890	C2, C3	64	95	79	0.13	0.20	0.28	0.33	0.38
		260 - 320	90 - 104	890 - 1020	C2, C3	55	83	69	0.13	0.18	0.25	0.28	0.33
N	**Cast Aluminium**	30	10	100	C2	366	460	410	0.25	0.38	0.45	0.50	0.55
		180	62	600	C2	244	306	275	0.23	0.33	0.40	0.45	0.50
	Wrought Aluminium	30	10	100	C2	366	460	410	0.10	0.15	0.25	0.30	0.36
		180	62	600	C2	244	306	275	0.20	0.28	0.36	0.45	0.50
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	C2	85	110	100	0.13	0.20	0.25	0.36	0.42
		200 - 250	68 - 87	670 - 855	C2	64	94	79	0.10	0.15	0.18	0.25	0.33
	Brass	100	38	370	C2	130	184	160	0.15	0.23	0.28	0.38	0.45
	Copper	60	21	200	C2	80	120	100	0.05 ❖	0.08	0.10	0.15	0.25

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

⚠ WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

T-A® Original Recommended Drilling Data | Metric (mm)

HSS Inserts | Flat Bottom Geometry

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	M/min TiN	M/min TiAlN	M/min TiCN	M/min AM200®
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	52	76	70	88
		150 - 200	50 - 70	500-700	HSS	47	70	62	81
		200 - 250	70 - 88	700-870	HSS	43	64	56	74
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	HSS	46	67	59	77
		125 - 175	46 - 62	450 - 600	HSS	43	64	56	74
		175 - 225	62 - 77	600 - 775	HSS	40	59	53	68
		225 - 275	77 - 96	775 - 940	HSS	37	56	47	65
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	43	64	56	74
		175 - 225	62 - 77	600 - 775	HSS	40	59	53	68
		225 - 275	77 - 96	775 - 940	HSS	37	56	47	65
		275 - 325	96 - 111	940 - 1090	SC	34	53	46	61
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	40	56	53	65
		175 - 225	62 - 77	600 - 775	HSS	37	53	47	61
		225 - 275	77 - 96	775 - 940	HSS	34	47	44	54
		275 - 325	96 - 111	940 - 1090	SC	32	44	41	51
		325 - 375	111 - 129	1090 - 1265	SC	29	41	38	47
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	SC	21	29	26	33
		300 - 350	104 - 121	1020 - 1180	SC	15	23	21	27
		350 - 400	121 - 139	1180 - 1365	SC	13	20	18	23
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	36	52	47	60
		150 - 250	50 - 88	500 - 850	HSS	32	44	41	51
		250 - 350	88 - 121	850 - 1180	SC	26	37	34	43
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	21	29	27	33
		200 - 250	70 - 88	700 - 870	SC	15	24	23	28
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC	7	10	9	13
		220 - 310	77 - 101	755 - 990	SC	6	9	7	10
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC	10	14	12	16
		220 - 310	77 - 101	755 - 990	SC	8	12	11	14
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC	20	27	26	34
		275 - 350	96 -121	940 - 1180	SC	15	24	21	28
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC	20	27	26	34
		275 - 350	96 - 121	940 - 1180	SC	15	24	21	28
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC	20	27	26	34
		185 - 275	65 - 96	640 - 940	SC	15	24	21	28
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC	20	27	26	34
		185 - 275	65 - 96	640 - 940	SC	15	24	21	28
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC	–	–	–	–
		500	160	1600	SC	–	–	–	–
		600	210	2000	N/A	–	–	–	–
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	SC	13	20	18	24
		400 - 500	139+	1365+	SC	8	12	10	13
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	46	67	59	77
		150 - 200	50 - 70	500 - 700	HSS	40	59	53	68
		200 - 220	70 - 77	700 - 755	HSS	34	53	46	61
		220 - 260	77 - 90	755 - 890	SC	29	46	38	53
		260 - 320	90 - 104	890 - 1020	SC	24	37	32	43
N	**Cast Aluminium**	30	10	100	HSS	160	228	198	–
		180	62	600	HSS	79	122	107	–
	Wrought Aluminium	30	10	100	HSS	160	228	198	261
		180	62	600	HSS	79	122	107	141
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	40	59	53	70
		200 - 250	68 - 87	670 - 855	SC	29	46	38	50
	Brass	100	38	370	HSS	46	67	59	78
	Copper	60	21	200	SC	35	45	40	53

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (mm/rev) by Diameter					
9.50 - 12.95	12.98 - 17.53	17.53 - 24.38	24.21 - 35.00	35.01 - 47.80	47.85 - 65.99
0.15	0.23	0.28	0.35	0.41	0.46
0.15	0.23	0.28	0.35	0.41	0.46
0.13	0.23	0.28	0.35	0.38	0.43
0.13 ❖	0.20	0.25	0.33	0.38	0.43
0.13 ❖	0.20	0.25	0.33	0.38	0.41
0.10 ❖	0.18	0.23	0.30	0.36	0.41
0.10 ❖	0.18	0.23	0.30	0.36	0.38
0.13	0.20	0.25	0.33	0.38	0.46
0.10	0.18	0.23	0.30	0.36	0.43
0.10	0.18	0.23	0.30	0.36	0.43
0.10	0.15	0.20	0.25	0.33	0.38
0.13	0.18	0.23	0.30	0.33	0.41
0.10	0.18	0.23	0.30	0.33	0.41
0.10	0.15	0.23	0.30	0.33	0.41
0.10	0.13	0.20	0.25	0.30	0.38
0.08	0.13	0.20	0.25	0.30	0.36
0.10 ❖	0.15	0.20	0.23	0.25	0.30
0.08 ❖	0.15	0.20	0.23	0.25	0.30
0.08 ❖	0.13	0.18	0.20	0.23	0.28
0.13 ❖	0.23	0.25	0.30	0.38	0.43
0.10 ❖	0.20	0.23	0.25	0.33	0.41
0.10 ❖	0.18	0.20	0.23	0.30	0.38
0.10	0.13	0.18	0.23	0.25	0.30
0.10	0.13	0.18	0.23	0.23	0.28
0.08 ❖	0.15	0.18	0.23	0.25	0.30
0.08 ❖	0.13	0.15	0.18	0.20	0.25
0.08 ❖	0.15	0.18	0.23	0.25	0.30
0.08 ❖	0.13	0.15	0.18	0.20	0.25
0.13 ❖	0.18	0.20	0.25	0.30	0.38
0.10 ❖	0.15	0.18	0.23	0.25	0.30
0.13 ❖	0.18	0.20	0.25	0.30	0.36
0.10 ❖	0.15	0.18	0.23	0.25	0.28
0.13 ❖	0.18	0.20	0.25	0.30	0.36
0.10 ❖	0.15	0.18	0.23	0.25	0.28
0.13 ❖	0.18	0.20	0.25	0.30	0.36
0.10 ❖	0.15	0.18	0.23	0.25	0.28
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
0.08 ❖	0.13	0.18	0.20	0.27	0.38
0.06 ❖	0.10	0.15	0.18	0.23	0.28
0.15	0.25	0.36	0.43	0.48	0.51
0.13	0.23	0.30	0.41	0.46	0.48
0.13	0.20	0.25	0.36	0.41	0.43
0.10	0.15	0.20	0.25	0.33	0.33
0.10	0.13	0.15	0.20	0.25	0.25
0.18	0.28	0.36	0.43	0.46	0.48
0.18	0.28	0.36	0.41	0.43	0.48
0.18	0.28	0.36	0.43	0.46	0.48
0.18	0.28	0.36	0.41	0.43	0.48
0.13	0.23	0.30	0.41	0.51	0.61
0.10	0.15	0.20	0.25	0.31	0.38
0.15	0.25	0.36	0.43	0.53	0.63
0.05 ❖	0.08	0.15	0.20	0.25	0.35

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

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T-A® Original Recommended Drilling Data | Metric (mm)

Carbide Inserts | Flat Bottom Geometry

ISO	Material	Hardness (BHN)	Carbide Grade	M/min				Feed Rate (mm/rev) by Diameter			
				 TiN	 TiAlN	 TiCN	 AM200®	9.50 - 12.95	12.98 - 17.53	17.54 - 24.38	24.41 - 35.00
P	**Free Machining Steel**	100 - 150	C2	82	110	98	126	0.17	0.26	0.32	0.39
	1118, 1215, 12L14, etc.	150 - 200	C2	73	94	85	110	0.15	0.24	0.30	0.35
		200 - 250	C2	67	88	76	102	0.13	0.22	0.28	0.32
	Low Carbon Steel	85 - 125	C2	79	102	94	117	0.17 ❖	0.22	0.28	0.37
	1010, 1020, 1025, 1522,	125 - 175	C2	67	88	76	102	0.15 ❖	0.22	0.28	0.35
	1144, etc.	175 - 225	C2	61	81	70	93	0.13 ❖	0.19	0.26	0.32
		225 - 275	C2	55	70	64	81	0.11 ❖	0.19	0.26	0.32
	Medium Carbon Steel	125 - 175	C2	67	88	76	102	0.15	0.22	0.28	0.35
	1030, 1040, 1050, 1527,	175 - 225	C2	61	81	72	93	0.13	0.19	0.26	0.32
	1140, 1151, etc.	225 - 275	C2	55	70	61	81	0.13	0.19	0.26	0.32
		275 - 325	C2	46	61	53	70	0.11	0.17	0.24	0.30
	Alloy Steel	125 - 175	C2	64	85	75	99	0.15	0.22	0.28	0.35
	4140, 5140, 8640, etc.	175 - 225	C2	59	79	67	91	0.13	0.19	0.26	0.32
		225 - 275	C2	55	70	61	81	0.13	0.19	0.26	0.32
		275 - 325	C2	52	66	58	76	0.11	0.17	0.24	0.30
		325 - 375	C2	44	58	50	67	0.09	0.15	0.22	0.28
	High Strength Alloy	225 - 300	C2	41	52	47	59	0.13 ❖	0.19	0.22	0.26
	4340, 4330V, 300M, etc.	300 - 350	C2	37	47	41	55	0.11 ❖	0.17	0.19	0.24
		350 - 400	C2	30	41	37	47	0.09 ❖	0.15	0.17	0.22
	Structural Steel	100 - 150	C2	62	81	72	93	0.17 ❖	0.24	0.30	0.35
	A36, A285, A516, etc.	150 - 250	C2	52	66	58	76	0.13 ❖	0.22	0.28	0.30
		250 - 350	C2	47	61	53	70	0.11 ❖	0.19	0.25	0.26
	Tool Steel	150 - 200	C2	41	58	49	67	0.09	0.15	0.19	0.24
	H-13, H-21, A-4, 0-2, S-3, etc.	200 - 250	C2	30	44	37	50	0.09	0.15	0.19	0.24
S	**High Temp Alloy**	140 - 220	C2	21	27	23	32	0.09 ❖	0.15	0.19	0.24
	Hastelloy B, Inconel 600, etc.	220 - 310	C2	15	21	18	24	0.09 ❖	0.13	0.17	0.22
	Titanium Alloy	140 - 220	C2	26	33	28	40	0.08 ❖	0.14	0.17	0.20
		220 - 310	C2	21	29	25	30	0.08 ❖	0.12	0.15	0.18
	Aerospace Alloy	185 - 275	C2	43	37	50	40	0.15 ❖	0.17	0.25	0.30
	S82	275 - 350	C2	33	28	38	32	0.13 ❖	0.15	0.23	0.25
M	**Stainless Steel 400 Series**	185 - 275	C2	43	56	50	64	0.15 ❖	0.20	0.25	0.30
	416, 420, etc.	275 - 350	C2	33	43	38	49	0.13 ❖	0.18	0.23	0.25
	Stainless Steel 300 Series	135 - 185	C2	28	37	33	40	0.13 ❖	0.17	0.21	0.25
	304, 316, 17-4PH, etc.	185 - 275	C2	21	28	25	32	0.11 ❖	0.15	0.19	0.21
	Super Duplex Stainless Steel	135 - 185	C2	22	29	26	33	0.10 ❖	0.14	0.17	0.20
		185 - 275	C2	17	22	19	26	0.08 ❖	0.12	0.15	0.17

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Carbide Grade	M/min TiN	M/min TiAlN	M/min TiCN	M/min AM200®	Feed Rate (mm/rev) by Diameter 9.50 - 12.95	12.98 - 17.53	17.54 - 24.38	24.41 - 35.00
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	C2	20	31	26	39	0.06 ❖	0.10	0.16	0.20
		500	C2	13	23	18	31	0.04 ❖	0.08	0.12	0.16
		600	C2	10	19	14	25	0.03 ❖	0.06	0.10	0.13
	Hardened Steel	300 - 400	C2	30	38	34	41	0.08 ❖	0.14	0.18	0.22
		400 - 500	C2	18	22	20	33	0.06 ❖	0.12	0.16	0.18
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	C2	82	120	108	137	0.17	0.26	0.32	0.41
		150 - 200	C2	70	104	87	119	0.15	0.24	0.28	0.38
		200 - 220	C2	61	94	79	108	0.13	0.19	0.26	0.32
		220 - 260	C2	55	81	67	93	0.11	0.17	0.24	0.28
		260 - 320	C2	47	70	58	81	0.11	0.15	0.22	0.24
N	**Cast Aluminium**	30	C2	160	228	198	–	0.22	0.32	0.41	0.43
		180	C2	79	122	107	–	0.19	0.28	0.35	0.39
	Wrought Aluminium	30	C2	292	368	328	390	0.12	0.18	0.23	0.25
		180	C2	195	245	220	260	0.10	0.16	0.20	0.22
	Aluminium Bronze	100 - 200	C2	73	95	85	105	0.10	0.16	0.20	0.29
		200 - 250	C2	55	81	68	87	0.08	0.12	0.14	0.20
	Brass	100	C2	112	160	138	185	0.12	0.18	0.22	0.30
	Copper	60	C2	68	105	85	117	0.04 ❖	0.06	0.08	0.12

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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)

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

Carbide Inserts | Diamond Coating

	Material	Carbide Grade	M/min Diamond Coating	Feed Rate (mm/rev) by Diameter 9.5 - 12.5	13 - 17.5	18 - 24	25 - 35
Polymer Matrix Composites	Carbon (hard)	N2	305 - 450	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Carbon Fibre	N2	305 - 450	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Carbon / Glass Fibre	N2	305 - 450	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Fibreglass	N2	305 - 450	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Graphite	N2	305 - 450	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Plastics	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Epoxy Resin	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Bismaleimide Resin	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Polyester Resin	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Phenolic Resin	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Rubber	N2	76 - 305	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
Metal Matrix Composites	Aluminium	N2	305	0.20	0.33	0.41	0.51
	Si < 10%	N2	305	0.20	0.33	0.41	0.51
	10% < Si < 15%	N2	259 - 305	0.20	0.33	0.41	0.51
	15% < SI < 20%	N2	198 - 259	0.20	0.33	0.41	0.51
	20% < Si < 25%	N2	152 - 198	0.20	0.33	0.41	0.51
	25% < Si	N2	61 - 152	0.20	0.33	0.41	0.51
	Brass	N2	76 - 152	0.20	0.33	0.41	0.51
	Bronze	N2	76 - 152	0.20	0.33	0.41	0.51
	Copper	N2	30 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Copper Alloys	N2	30 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Lead Alloys	N2	30 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Magnesium Alloys	N2	30 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Precious Metals	N2	30 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
Ceramic Matrix Composites	Carbide (green)	N2	15 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Ceramic (green)	N2	15 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36
	Ceramic (pre-sintered)	N2	15 - 76	0.10 - 0.15	0.20 - 0.25	0.25 - 0.30	0.30 - 0.36

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 50 M/min and 0.20 mm/rev for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 37.5 M/min and 0.18 mm/rev.

50 • 0.75 = 37.5 M/min	0.20 • 0.90 = 0.18 mm/rev

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Tap Drill Information and Formulas | Metric (mm)

Metric Profile Screw Thread

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
12 x 1.75	10.2mm	0.4016"	79%	0.075mm	10.28mm	76%
12 x 1.75	13/32"	0.4063"	74%	0.075mm	10.40mm	71%
12 x 1.25	27/64"	0.4219"	79%	0.075mm	10.79mm	74%
12 x 1.25	10.8mm	0.4252"	74%	0.075mm	10.88mm	69%
14 x 20	15/32"	0.4688"	81%	0.075mm	11.98mm	78%
14 x 20	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%
16 x 1.5	37/64"	0.5781"	68%	0.075mm	14.76mm	64%
18 x 2.5	15.5mm	0.6102"	77%	0.075mm	15.58mm	75%
18 x 1.5	16.5mm	0.6496"	77%	0.075mm	16.58mm	73%
18 x 1.5	21/32"	0.6563"	68%	0.075mm	16.75mm	64%
20 x 2.5	11/16"	0.6875"	78%	0.075mm	17.54mm	76%
20 x 2.5	17.5mm	0.6890"	77%	0.075mm	17.58mm	74%
20 x 1.5	18.5mm	0.7283"	77%	0.075mm	18.58mm	73%
20 x 1.5	47/64"	0.7344"	69%	0.075mm	18.66mm	65%
22 x 2.5	49/64"	0.7656"	79%	0.075mm	19.52mm	76%
22 x 2.5	19.5mm	0.7677"	77%	0.075mm	19.58mm	75%
22 x 1.5	20.5mm	0.8071"	77%	0.075mm	20.58mm	73%
22 x 1.5	13/16"	0.8125"	70%	0.075mm	20.71mm	66%
24 x 3	13/16"	0.8125"	86%	0.075mm	20.71mm	84%
24 x 3	21.0mm	0.8268"	76%	0.075mm	21.08mm	75%
24 x 2	22.0mm	0.8661"	77%	0.075mm	22.08mm	74%
24 x 2	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 (bar)

5. **Tool Power = ((mm/rev) • RPM • K_m • DIA^2) / 210604.8**

where:

Tool Power = tool power (HP)
mm/rev = feed rate (mm/rev)
RPM = revolutions per minute (rev/min)
K_m = specific cutting energy (bar)
DIA = diameter of drill (mm)

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	–	0.075mm	11.19mm	–
3/8 - 18	9/16	0.5625	–	0.075mm	14.76mm	–
1/2 - 14	45/64	0.7031	–	0.075mm	18.33mm	–
3/4 - 14	29/32	0.9063	–	0.075mm	23.89mm	–

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

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

$$\% \text{ Thread} = \left[\frac{76.93}{\text{Pitch (mm)}}\right]\left[\text{Basic Major Diameter of Thread (mm)} - \text{Drill Hole Size (mm)}\right]$$

Material Constants

Type of Material	Hardness	K_m (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
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
Titanium Alloy	–	4.96
Aluminium 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 requirements.
- 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*.

Coolant Recommendations | Metric (mm)

HSS Drill Inserts

ISO	Material	Pressure or Flow Rate	9.5 - 12.5	13 - 17	18 - 24	25 - 35	36 - 50	51 - 76	76 - 102
P	**Free Machining Steel**	BAR	12 - 13	7 - 8	7 - 10	6 - 8	5 - 7	4	5 - 6
	1118, 1215, 12L14, etc.	LPM	9.5 - 9.8	10.6 - 11.4	16.7 - 19.7	26.5 - 30.3	45.4 - 53.0	114 - 125	144 - 167
	Low Carbon Steel	BAR	11 - 12	5 - 6	5 - 7	4 - 6	4 - 5	2 - 3	3 - 5
	1010, 1020, 1025, 1522, 1144, etc.	LPM	9.1 - 9.5	9.1 - 9.8	14.0 - 15.9	22.7 - 26.5	41.6 - 45.4	98 - 114	125 - 144
	Medium Carbon Steel	BAR	11	5 - 6	5 - 6	4 - 5	3 - 5	2 - 3	3 - 5
	1030, 1040, 1050, 1527, 1140, 1151, etc.	LPM	8.7 - 9.1	8.7 - 9.8	13.6 - 15.5	18.9 - 22.7	37.9 - 45.4	98 - 114	125 - 144
	Alloy Steel	BAR	11	5	5 - 6	3 - 5	3 - 4	2	3
	4140, 5140, 8640, etc.	LPM	8.7 - 9.1	8.3 - 9.1	13.2 - 14.8	18.9 - 22.7	31.9 - 41.6	98 - 106	114 - 125
	High Strength Alloy	BAR	10 - 11	4	3	2	2	1 - 2	2
	4340, 4330V, 300M, etc.	LPM	8.7 - 9.1	7.9 - 8.3	11.0 - 11.7	15.1 - 18.9	26.5 - 30.3	79 - 87	87 - 98
	Structural Steel	BAR	11	5 - 6	5 - 6	3 - 4	3	2	3
	A36, A285, A516, etc.	LPM	8.7 - 9.1	9.1 - 9.8	13.2 - 14.8	18.9 - 22.7	34.1 - 37.9	87 - 98	114 - 125
	Tool Steel	BAR	10 - 11	4	3	2	2	1 - 2	2
	H-13, H-21, A-4, 0-2, S-3, etc.	LPM	8.7 - 9.1	7.9 - 8.3	11.0 - 11.7	15.1 - 18.9	26.5 - 30.3	79 - 87	87 - 98
S	**High Temp Alloy**	BAR	10 - 11	4 - 5	3 - 4	2	2	2	3
	Hastelloy B, Inconel 600, etc.	LPM	8.7 - 9.1	8.3 - 8.7	11.7 - 12.1	15.1 - 18.9	26.5 - 30.3	87 - 98	125
	Titanium Alloy	BAR	10 - 11	4 - 5	3 - 4	2	2	2	3
		LPM	8.7 - 9.1	8.3 - 8.7	11.7 - 12.1	15.1 - 18.9	26.5 - 30.3	87 - 98	125
	Aerospace Alloy	BAR	10 - 11	4 - 5	3 - 4	2	2	2	3
	S82	LPM	8.7 - 9.1	8.3 - 8.7	11.7 - 12.1	15.1 - 18.9	26.5 - 30.3	87 - 98	125
M	**Stainless Steel 400 Series**	BAR	11.8	5.9	5.2	3.8	3.5	2	3.1
	416, 420, etc.	LPM	9.5	9.8	14	23	38	98	117
	Stainless Steel 300 Series	BAR	11.8	5.9	5.2	3.8	3.5	2	3.1
	304, 316, 17-4PH, etc.	LPM	9.5	9.8	14	23	38	98	117
	Super Duplex Stainless Steel	BAR	11.8	5.9	5.2	3.8	3.5	2	3.1
		LPM	9.5	9.8	14	23	38	98	117
H	**Wear Plate**	BAR	10.7	4.2	3.5	2	2	1.7	2
	Hardox, AR400, T-1, etc.	LPM	9.1	8.3	11.7	19	30	87	98
	Hardened Steel	BAR	10.7	4.2	3.5	2	2	1.7	2
		LPM	9.1	8.3	11.7	19	30	87	98
K	**SG / Nodular Cast Iron**	BAR	11	4.5	4.2	2.8	2.4	2	2.4
		LPM	9.1	8.7	12.5	19	34	98	106
	Grey / White Iron	BAR	11	4.5	4.2	2.8	2.4	2	2.4
		LPM	9.1	8.7	12.5	19	34	98	106
N	**Cast Aluminium**	BAR	14.5	12.4	15.8	11	8.6	3.5	5.5
		LPM	10	14	23	34	61	125	159
	Wrought Aluminium	BAR	14.5	12.4	15.8	11	8.6	3.5	5.5
		LPM	10	14	23	34	61	125	159
	Aluminium Bronze	BAR	12.8	8.3	9.65	7.95	6.9	3.5	6.2
		LPM	9.6	11.4	19.7	30.3	53	125	167
	Brass	BAR	11	4.5	4.2	2.8	2.4	2	2.4
		LPM	9.1	8.7	12.5	19	34	98	106
	Copper	BAR	12.8	8.3	9.65	7.95	6.9	3.5	6.2
		LPM	9.6	11.4	19.7	30.3	53	125	167

Deep Hole Drilling Coolant Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Pressure and Flow	1.3	1.5	2	2	3

Recommended Coolant Example

If the recommended pressure and flow is 12 bar and 22 LPM for a standard length holder, then the adjusted pressure and flow for a 3XL holder would be 36 bar and 66 LPM.

12 • 3 = 36 bar	22 • 3 = 66 LPM

⚠ WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

IMPORTANT: The coolant pressure and flow rate recommendations above represent a good approximation to obtain optimum tool life and chip evacuation at Allied Machine recommended speeds and feeds. If lower coolant capabilities exist in a drilling application, the T-A® drilling system will still function at reduced penetration rates. Contact our Application Engineering department for a more specific recommendation of coolant requirements and/or speeds and feeds.

Coolant Recommendations | Metric (mm)

Carbide Drill Inserts

ISO	Material	Pressure or Flow Rate	9.5 - 12.5	13 - 17	18 - 24	25 - 35	36 - 47
P	**Free Machining Steel**	BAR	17 - 20	17	15	15	20
	1118, 1215, 12L14, etc.	LPM	12.2	16.3	25.2	41.5	71.9
	Low Carbon Steel	BAR	18	11	11	12	9
	1010, 1020, 1025, 1522, 1144, etc.	LPM	11.4	13.3	20.6	36.5	62.0
	Medium Carbon Steel	BAR	17	10	10	10	8
	1030, 1040, 1050, 1527, 1140, 1151, etc.	LPM	11.3	12.5	20.0	33.8	57.0
	Alloy Steel	BAR	17	9	10	8	7
	4140, 5140, 8640, etc.	LPM	11.1	12.3	19.3	30.0	55.8
	High Strength Alloy	BAR	15	5	4	3	3
	4340, 4330V, 300M, etc.	LPM	10.4	9.1	12.6	18.8	33.6
	Structural Steel	BAR	16	9	8	7	5
	A36, A285, A516, etc.	LPM	10.8	12.0	17.5	27.8	47.1
	Tool Steel	BAR	15	5	5	3	3
	H-13, H-21, A-4, 0-2, S-3, etc.	LPM	10.4	9.1	13.6	19.7	36.5
S	**High Temp Alloy**	BAR	17	11	12	11	9
	Hastelloy B, Inconel 600, etc.	LPM	11.1	13.5	21.9	35.4	62.0
	Titanium Alloy	BAR	17	11	12	11	9
		LPM	11.1	13.5	21.9	35.4	62.0
	Aerospace Alloy	BAR	17	11	12	11	9
	S82	LPM	11.1	13.5	21.9	35.4	62.0
M	**Stainless Steel 400 Series**	BAR	22.7	16.5	17.9	17.2	13.1
	416, 420, etc.	LPM	13	16.3	26.3	44.2	75
	Stainless Steel 300 Series	BAR	22.7	16.5	17.9	17.2	13.1
	304, 316, 17-4PH, etc.	LPM	13	16.3	26.3	44.2	75
	Super Duplex Stainless Steel	BAR	22.7	16.5	17.9	17.2	13.1
		LPM	13	16.3	26.3	44.2	75
H	**Wear Plate**	BAR	14.5	5.2	4.8	3.4	3.1
	Hardox, AR400, T-1, etc.	LPM	10.4	9.1	13.6	19.7	36.5
	Hardened Steel	BAR	14.5	5.2	4.8	3.4	3.1
		LPM	10.4	9.1	13.6	19.7	36.5
K	**SG / Nodular Cast Iron**	BAR	15.5	7.2	6.2	6.2	5.5
		LPM	10.7	10.8	15.4	26.5	48.7
	Grey / White Iron	BAR	15.5	7.2	6.2	6.2	5.5
		LPM	10.7	10.8	15.4	26.5	48.7
N	**Cast Aluminium**	BAR	24.1	22	21.7	19.6	13.8
		LPM	13.4	18.8	29	47.2	77
	Wrought Aluminium	BAR	24.1	22	21.7	19.6	13.8
		LPM	13.4	18.8	29	47.2	77
	Aluminium Bronze	BAR	20	16.5	16.5	15.2	12
		LPM	12.2	16.3	25.2	41.5	71.9
	Brass	BAR	24.1	22	21.7	19.6	13.8
		LPM	13.4	18.8	29	47.2	77
	Copper	BAR	20	16.5	16.5	15.2	12
		LPM	12.2	16.3	25.2	41.5	71.9

Deep Hole Drilling Coolant Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Pressure and Flow	1.3	1.5	2	2	3

Recommended Coolant Example

If the recommended pressure and flow is 12 bar and 22 LPM for a standard length holder, then the adjusted pressure and flow for a 3XL holder would be 36 bar and 66 LPM.

12 • 3 = 36 bar	22 • 3 = 66 LPM

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

IMPORTANT: The coolant pressure and flow rate recommendations above represent a good approximation to obtain optimum tool life and chip evacuation at Allied Machine recommended speeds and feeds. If lower coolant capabilities exist in a drilling application, the T-A® drilling system will still function at reduced penetration rates. Contact our Application Engineering department for a more specific recommendation of coolant requirements and/or speeds and feeds.

GEN2 T-A® Recommended Drilling Data | Imperial (inch)

HSS Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM AM200®	Feed Rate (IPR) by Diameter 3/8 - 1/2	Feed Rate (IPR) by Diameter 33/64 - 11/16
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	200	325	0.008	0.012
		150 - 200	50 - 70	500-700	HSS	180	300	0.007	0.011
		200 - 250	70 - 88	700-870	HSS	160	280	0.006	0.010
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	HSS	170	290	0.008 ❖	0.010
		125 - 175	46 - 62	450 - 600	HSS	160	275	0.007 ❖	0.010
		175 - 225	62 - 77	600 - 775	HSS	150	260	0.006 ❖	0.009
		225 - 275	77 - 96	775 - 940	HSS	140	240	0.005 ❖	0.009
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	160	275	0.007	0.010
		175 - 225	62 - 77	600 - 775	HSS	150	260	0.006	0.009
		225 - 275	77 - 96	775 - 940	HSS	140	240	0.006	0.009
		275 - 325	96 - 111	940 - 1090	SC	130	225	0.005	0.008
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	150	240	0.007	0.010
		175 - 225	62 - 77	600 - 775	HSS	140	225	0.006	0.009
		225 - 275	77 - 96	775 - 940	HSS	130	210	0.006	0.009
		275 - 325	96 - 111	940 - 1090	SC	120	195	0.005	0.008
		325 - 375	111 - 129	1090 - 1265	SC	110	180	0.004	0.007
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	SC	80	125	0.006 ❖	0.009
		300 - 350	104 - 121	1020 - 1180	SC	60	100	0.005 ❖	0.008
		350 - 400	121 - 139	1180 - 1365	SC	50	80	0.004 ❖	0.007
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	140	235	0.008 ❖	0.011
		150 - 250	50 - 88	500 - 850	HSS	120	190	0.006 ❖	0.010
		250 - 350	88 - 121	850 - 1180	SC	100	160	0.005 ❖	0.009
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	80	125	0.004	0.007
		200 - 250	70 - 88	700 - 870	SC	60	105	0.004	0.007
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC	30	45	0.004 ❖	0.007
		220 - 310	77 - 101	755 - 990	SC	25	40	0.004 ❖	0.006
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC	35	55	0.004 ❖	0.007
		220 - 310	77 - 101	755 - 990	SC	30	50	0.003 ❖	0.006
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC	75	110	0.006 ❖	0.008
		275 - 350	96 -121	940 - 1180	SC	60	100	0.005 ❖	0.007
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC	75	110	0.006 ❖	0.008
		275 - 350	96 - 121	940 - 1180	SC	60	100	0.005 ❖	0.007
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC	75	110	0.003 ❖	0.007
		185 - 275	65 - 96	640 - 940	SC	60	100	0.003 ❖	0.006
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC	60	85	0.003 ❖	0.007
		185 - 275	65 - 96	640 - 940	SC	50	70	0.003 ❖	0.006
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC	45	70	0.003 ❖	0.006
		500	160	1600	SC	35	45	0.002 ❖	0.005
		600	210	2000	–	–	–	0.004 ❖	0.006
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	SC	50	95	–	–
		400 - 500	139+	1365+	SC	35	45	0.002 ❖	0.005
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	170	290	0.008	0.012
		150 - 200	50 - 70	500 - 700	HSS	150	260	0.007	0.011
		200 - 220	70 - 77	700 - 755	HSS	130	225	0.006	0.009
		220 - 260	77 - 90	755 - 890	SC	110	190	0.005	0.008
		260 - 320	90 - 104	890 - 1020	SC	90	155	0.005	0.007
N	**Cast Aluminium**	30	10	100	HSS	600	–	0.009	0.015
		180	62	600	HSS	300	–	0.008	0.013
	Wrought Aluminium	30	10	100	HSS	600	900	0.005	0.013
		180	62	600	HSS	300	650	0.005	0.007
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	170	270	0.006	0.009
		200 - 250	68 - 87	670 - 855	SC	130	210	0.005	0.007
	Brass	100	38	370	HSS	300	470	0.007	0.011
	Copper	60	21	200	SC	130	190	0.003 ❖	0.004

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (IPR) by Diameter				
45/64 - 15/16	31/32 - 1-3/8	1-13/32 - 1-7/8	1-29/32 - 2-9/16	2-19/32 - 4-1/2
0.016	0.019	0.020	0.023	0.028
0.015	0.017	0.020	0.023	0.028
0.014	0.016	0.020	0.023	0.028
0.014	0.018	0.019	0.023	0.027
0.014	0.017	0.019	0.023	0.027
0.013	0.016	0.018	0.021	0.024
0.013	0.016	0.018	0.021	0.024
0.014	0.017	0.019	0.023	0.027
0.013	0.016	0.018	0.021	0.024
0.013	0.016	0.018	0.021	0.024
0.012	0.015	0.016	0.019	0.022
0.014	0.017	0.017	0.019	0.022
0.013	0.016	0.017	0.019	0.022
0.013	0.016	0.017	0.019	0.022
0.012	0.015	0.015	0.017	0.020
0.011	0.014	0.015	0.017	0.020
0.011	0.013	0.014	0.017	0.020
0.010	0.012	0.014	0.017	0.020
0.009	0.011	0.012	0.015	0.018
0.015	0.017	0.018	0.021	0.026
0.013	0.015	0.016	0.019	0.024
0.012	0.013	0.014	0.017	0.020
0.010	0.012	0.012	0.015	0.017
0.010	0.012	0.012	0.015	0.017
0.009	0.011	0.012	0.015	0.017
0.008	0.010	0.010	0.012	0.014
0.008	0.010	0.012	0.015	0.017
0.007	0.009	0.010	0.012	0.014
0.009	0.011	0.014	0.016	0.020
0.008	0.010	0.012	0.014	0.018
0.009	0.011	0.014	0.016	0.020
0.008	0.010	0.012	0.014	0.018
0.008	0.011	0.014	0.016	0.020
0.007	0.010	0.012	0.014	0.018
0.008	0.011	0.014	0.016	0.020
0.007	0.010	0.012	0.014	0.018
0.008	0.009	0.012	0.016	0.018
0.007	0.008	0.010	0.012	0.016
0.009	0.011	0.012	0.016	0.018
–	–	–	–	–
0.007	0.009	0.010	0.012	0.016
0.016	0.020	0.024	0.027	0.030
0.015	0.019	0.022	0.025	0.028
0.013	0.017	0.018	0.021	0.024
0.011	0.014	0.014	0.017	0.020
0.010	0.012	0.012	0.014	0.016
0.018	0.023	0.022	0.025	0.025
0.016	0.020	0.022	0.025	0.025
0.016	0.020	0.022	0.025	0.025
0.012	0.014	0.022	0.025	0.025
0.012	0.015	0.017	0.019	0.021
0.009	0.011	0.014	0.016	0.018
0.013	0.018	0.019	0.021	0.023
0.007	0.010	0.009	0.011	0.012

Deep Hole Drilling Speed and Feed Adjustment

	Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

GEN2 T-A® Recommended Drilling Data | Imperial (inch)

Carbide Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM AM200®	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	C1	480	0.008	0.012	0.016	0.019
		150 - 200	50 - 70	500-700	C1	415	0.007	0.011	0.015	0.017
		200 - 250	70 - 88	700-870	C1	390	0.006	0.010	0.014	0.016
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	C1	450	0.008 ❖	0.010	0.014	0.018
		125 - 175	46 - 62	450 - 600	C1	390	0.007 ❖	0.010	0.014	0.017
		175 - 225	62 - 77	600 - 775	C1	355	0.006 ❖	0.009	0.013	0.016
		225 - 275	77 - 96	775 - 940	C1	310	0.005 ❖	0.009	0.013	0.016
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	C1	390	0.007	0.010	0.014	0.017
		175 - 225	62 - 77	600 - 775	C1	355	0.006	0.009	0.013	0.016
		225 - 275	77 - 96	775 - 940	C1	310	0.006	0.009	0.013	0.016
		275 - 325	96 - 111	940 - 1090	C1	265	0.005	0.008	0.012	0.015
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	C1	375	0.007	0.010	0.014	0.017
		175 - 225	62 - 77	600 - 775	C1	345	0.006	0.009	0.013	0.016
		225 - 275	77 - 96	775 - 940	C1	310	0.006	0.009	0.013	0.016
		275 - 325	96 - 111	940 - 1090	C1	285	0.005	0.008	0.012	0.015
		325 - 375	111 - 129	1090 - 1265	C1	255	0.004	0.007	0.011	0.014
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	C1	230	0.006 ❖	0.009	0.011	0.013
		300 - 350	104 - 121	1020 - 1180	C1	205	0.005 ❖	0.008	0.010	0.012
		350 - 400	121 - 139	1180 - 1365	C1	185	0.004 ❖	0.007	0.009	0.011
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	C1	355	0.008 ❖	0.011	0.015	0.017
		150 - 250	50 - 88	500 - 850	C1	285	0.006 ❖	0.010	0.013	0.015
		250 - 350	88 - 121	850 - 1180	C1	265	0.005 ❖	0.009	0.012	0.013
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	C1	255	0.007	0.007	0.010	0.012
		200 - 250	70 - 88	700 - 870	C1	195	0.007	0.007	0.010	0.012
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	C2	120	0.004 ❖	0.007	0.009	0.011
		220 - 310	77 - 101	755 - 990	C2	95	0.004 ❖	0.006	0.008	0.010
	Titanium Alloy	140 - 220	49 - 77	480 - 755	C2	140	0.004 ❖	0.007	0.008	0.011
		220 - 310	77 - 101	755 - 990	C2	110	0.003 ❖	0.006	0.007	0.009
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	C2	240	0.005 ❖	0.006	0.007	0.009
		275 - 350	96 -121	940 - 1180	C2	180	0.004 ❖	0.005	0.006	0.008
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	C2	240	0.007 ❖	0.009	0.012	0.014
		275 - 350	96 - 121	940 - 1180	C2	180	0.006 ❖	0.008	0.011	0.012
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	C2	240	0.006 ❖	0.007	0.009	0.012
		185 - 275	65 - 96	640 - 940	C2	180	0.005 ❖	0.006	0.008	0.009
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	C2	125	0.005 ❖	0.007	0.008	0.010
		185 - 275	65 - 96	640 - 940	C2	100	0.004 ❖	0.006	0.007	0.009

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM AM200®	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	C2	150	0.003 ❖	0.005	0.008	0.010
		500	160	1600	C2	120	0.002 ❖	0.004	0.006	0.008
		600	210	2000	C2	100	0.001 ❖	0.003	0.005	0.006
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	C1	150	0.004 ❖	0.006	0.009	0.011
		400 - 500	139+	1365+	C1	120	0.003 ❖	0.005	0.008	0.010
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	C2	500	0.008	0.012	0.015	0.019
		150 - 200	50 - 70	500 - 700	C2	480	0.007	0.011	0.013	0.017
		200 - 220	70 - 77	700 - 755	C2	430	0.006	0.009	0.012	0.015
		220 - 260	77 - 90	755 - 890	C2	370	0.005	0.008	0.011	0.013
		260 - 320	90 - 104	890 - 1020	C2	335	0.005	0.007	0.010	0.011
N	**Cast Aluminium**	30	10	100	C2	975	0.009	0.015	0.018	0.023
		180	62	600	C2	730	0.008	0.013	0.016	0.020
	Wrought Aluminium	30	10	100	C2	1385	0.005	0.013	0.016	0.020
		180	62	600	C2	975	0.005	0.007	0.012	0.014
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	C2	360	0.006	0.009	0.012	0.015
		200 - 250	68 - 87	670 - 855	C2	300	0.005	0.007	0.009	0.011
	Brass	100	38	370	C2	650	0.007	0.011	0.013	0.018
	Copper	60	21	200	C2	420	0.003 ❖	0.004	0.007	0.010

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

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

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

T-A® Original Recommended Drilling Data | Imperial (inch)

HSS Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	HSS Grade	SFM TiN	SFM TiAlN	SFM TiCN	Feed Rate (IPR) by Diameter 3/8 - 1/2	Feed Rate (IPR) by Diameter 33/64 - 11/16
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	200	280	260	0.007	0.010
		150 - 200	50 - 70	500-700	HSS	180	260	235	0.007	0.010
		200 - 250	70 - 88	700-870	HSS	160	240	210	0.006	0.010
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	HSS	170	250	220	0.006 ❖	0.009
		125 - 175	46 - 62	450 - 600	HSS	160	240	210	0.006 ❖	0.009
		175 - 225	62 - 77	600 - 775	HSS	150	225	195	0.005 ❖	0.008
		225 - 275	77 - 96	775 - 940	HSS	140	210	180	0.005 ❖	0.008
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	160	240	210	0.006	0.009
		175 - 225	62 - 77	600 - 775	HSS	150	225	195	0.005	0.008
		225 - 275	77 - 96	775 - 940	HSS	140	210	180	0.005	0.008
		275 - 325	96 - 111	940 - 1090	SC, PC	130	195	170	0.004	0.007
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	150	210	195	0.006	0.008
		175 - 225	62 - 77	600 - 775	HSS	140	195	180	0.005	0.008
		225 - 275	77 - 96	775 - 940	HSS	130	180	170	0.005	0.007
		275 - 325	96 - 111	940 - 1090	SC, PC	120	170	155	0.004	0.006
		325 - 375	111 - 129	1090 - 1265	SC, PC	110	155	145	0.003	0.006
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	SC, PC	80	110	100	0.005 ❖	0.007
		300 - 350	104 - 121	1020 - 1180	SC, PC	60	85	80	0.004 ❖	0.007
		350 - 400	121 - 139	1180 - 1365	PC	50	70	65	0.003 ❖	0.006
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	140	200	180	0.006 ❖	0.010
		150 - 250	50 - 88	500 - 850	HSS	120	170	155	0.005 ❖	0.009
		250 - 350	88 - 121	850 - 1180	SC, PC	100	140	130	0.003 ❖	0.008
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	80	110	105	0.004	0.006
		200 - 250	70 - 88	700 - 870	SC, PC	60	90	85	0.004	0.006
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC, PC	30	40	35	0.003 ❖	0.007
		220 - 310	77 - 101	755 - 990	PC	25	35	30	0.003 ❖	0.006
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC, PC	35	50	45	0.003 ❖	0.007
		220 - 310	77 - 101	755 - 990	PC	30	45	35	0.003 ❖	0.006
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC, PC	75	105	95	0.006 ❖	0.008
		275 - 350	96 -121	940 - 1180	SC, PC	60	90	80	0.005 ❖	0.007
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC, PC	75	105	95	0.009	0.010
		275 - 350	96 - 121	940 - 1180	SC, PC	60	90	80	0.008	0.009
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC, PC	75	105	95	0.007	0.007
		185 - 275	65 - 96	640 - 940	SC, PC	60	90	80	0.006	0.006
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC, PC	60	80	70	0.005	0.005
		185 - 275	65 - 96	640 - 940	SC, PC	50	65	60	0.004	0.005
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC, PC	45	70	55	0.003 ❖	0.006
		500	160	1600	PC	35	45	40	0.002 ❖	0.005
		600	210	2000	N/A	–	–	–	–	–
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	PC	50	95	70	0.003 ❖	0.006
		400 - 500	139+	1365+	PC	35	45	40	0.002 ❖	0.005
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	170	250	220	0.007	0.012
		150 - 200	50 - 70	500 - 700	HSS	150	225	195	0.006	0.011
		200 - 220	70 - 77	700 - 755	HSS	130	195	170	0.006	0.009
		220 - 260	77 - 90	755 - 890	SC, PC	110	165	145	0.005	0.007
		260 - 320	90 - 104	890 - 1020	SC, PC	90	135	120	0.004	0.006
N	**Cast Aluminium**	30	10	100	HSS	600	850	750	0.008	0.013
		180	62	600	HSS	300	450	400	0.008	0.013
	Wrought Aluminium	30	10	100	HSS	600	850	750	0.004	0.006
		180	62	600	HSS	300	450	400	0.008	0.013
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	170	250	220	0.006	0.011
		200 - 250	68 - 87	670 - 855	SC	130	190	170	0.005	0.007
	Brass	100	38	370	HSS	300	445	400	0.007	0.012
	Copper	60	21	200	SC	130	165	150	0.002 ❖	0.003

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (IPR) by Diameter				
45/64 - 15/16	31/32 - 1-3/8	1-13/32 - 1-7/8	1-29/32 - 2-9/16	2-19/32 - 4-1/2
0.013	0.016	0.020	0.023	0.028
0.013	0.016	0.020	0.023	0.028
0.013	0.016	0.020	0.023	0.028
0.012	0.015	0.019	0.023	0.027
0.012	0.015	0.019	0.023	0.027
0.010	0.014	0.018	0.021	0.024
0.010	0.014	0.018	0.021	0.024
0.012	0.015	0.019	0.023	0.027
0.010	0.014	0.018	0.021	0.024
0.010	0.014	0.018	0.021	0.024
0.009	0.012	0.016	0.019	0.022
0.010	0.014	0.017	0.019	0.022
0.010	0.014	0.017	0.019	0.022
0.010	0.014	0.017	0.019	0.022
0.009	0.012	0.015	0.017	0.020
0.009	0.012	0.015	0.017	0.020
0.009	0.010	0.014	0.017	0.020
0.009	0.010	0.014	0.017	0.020
0.008	0.009	0.012	0.015	0.018
0.012	0.014	0.018	0.021	0.026
0.010	0.012	0.016	0.019	0.024
0.009	0.010	0.014	0.017	0.020
0.008	0.010	0.012	0.015	0.017
0.008	0.010	0.012	0.015	0.017
0.008	0.010	0.012	0.015	–
0.007	0.008	0.010	0.012	–
0.008	0.010	0.012	0.015	–
0.007	0.008	0.010	0.012	–
0.009	0.010	0.014	0.016	0.020
0.008	0.008	0.012	0.014	0.018
0.011	0.012	0.013	0.014	0.015
0.010	0.011	0.012	0.013	0.014
0.008	0.008	0.009	0.009	0.010
0.007	0.007	0.008	0.008	0.009
0.006	0.006	0.007	0.008	0.008
0.005	0.006	0.006	0.007	0.007
0.008	0.009	0.012	0.016	0.018
0.007	0.008	0.010	0.012	0.016
–	–	–	–	–
0.008	0.009	0.012	0.016	0.018
0.007	0.008	0.010	0.012	0.016
0.016	0.020	0.024	0.027	0.030
0.014	0.018	0.022	0.025	0.028
0.012	0.016	0.018	0.021	0.024
0.009	0.012	0.014	0.017	0.020
0.007	0.009	0.012	0.014	0.016
0.016	0.020	0.022	0.025	0.025
0.016	0.018	0.022	0.025	0.025
0.010	0.012	0.022	0.025	0.025
0.016	0.018	0.022	0.025	0.025
0.014	0.018	0.022	0.026	0.028
0.009	0.012	0.014	0.017	0.020
0.016	0.020	0.024	0.028	0.030
0.006	0.008	0.012	0.014	0.016

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

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T-A® Original Recommended Drilling Data | Imperial (inch)

Carbide Inserts

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM TiAlN	SFM TiCN	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8	1-13/32 - 1-7/8
P	**Free Machining Steel**	100 - 150	38 - 50	370-500	C5	320	420	375	0.008	0.012	0.015	0.018	0.021
	1118, 1215, 12L14, etc.	150 - 200	50 - 70	500-700	C5	280	360	325	0.007	0.011	0.014	0.016	0.019
		200 - 250	70 - 88	700-870	C5	260	340	295	0.006	0.010	0.013	0.015	0.017
	Low Carbon Steel	85 - 125	30 - 46	300-450	C5	300	390	360	0.008 ❖	0.010	0.013	0.017	0.019
	1010, 1020, 1025, 1522,	125 - 175	46 - 62	450 - 600	C5	260	340	295	0.007 ❖	0.010	0.013	0.016	0.018
	1144, etc.	175 - 225	62 - 77	600 - 775	C5	240	310	270	0.006 ❖	0.009	0.012	0.015	0.017
		225 - 275	77 - 96	775 - 940	C5	210	270	245	0.005 ❖	0.009	0.012	0.015	0.017
	Medium Carbon Steel	125 - 175	46 - 62	450 - 600	C5	260	340	295	0.007	0.010	0.013	0.016	0.018
	1030, 1040, 1050, 1527,	175 - 225	62 - 77	600 - 775	C5	240	310	275	0.006	0.009	0.012	0.015	0.017
	1140, 1151, etc.	225 - 275	77 - 96	775 - 940	C5	210	270	235	0.006	0.009	0.012	0.015	0.017
		275 - 325	96 - 111	940 - 1090	C5	180	230	205	0.005	0.008	0.011	0.014	0.016
	Alloy Steel	125 - 175	46 - 62	450 - 600	C5	250	325	285	0.007	0.010	0.013	0.016	0.018
	4140, 5140, 8640, etc.	175 - 225	62 - 77	600 - 775	C5	230	300	260	0.006	0.009	0.012	0.015	0.017
		225 - 275	77 - 96	775 - 940	C5	210	270	235	0.006	0.009	0.012	0.015	0.017
		275 - 325	96 - 111	940 - 1090	C5	200	250	225	0.005	0.008	0.011	0.014	0.016
		325 - 375	111 - 129	1090 - 1265	C5	170	220	195	0.004	0.007	0.010	0.013	0.015
	High Strength Alloy	225 - 300	77 - 104	600 - 1020	C5	160	200	180	0.006 ❖	0.009	0.010	0.012	0.015
	4340, 4330V, 300M, etc.	300 - 350	104 - 121	1020 - 1180	C5	140	180	160	0.005 ❖	0.008	0.009	0.011	0.014
		350 - 400	121 - 139	1180 - 1365	C5	120	160	140	0.004 ❖	0.007	0.008	0.010	0.012
	Structural Steel	100 - 150	38 - 50	370 - 500	C5	240	310	275	0.008 ❖	0.011	0.014	0.016	0.018
	A36, A285, A516, etc.	150 - 250	50 - 88	500 - 850	C5	200	250	225	0.006 ❖	0.010	0.012	0.014	0.016
		250 - 350	88 - 121	850 - 1180	C5	180	230	205	0.005 ❖	0.009	0.011	0.012	0.014
	Tool Steel	150 - 200	50 - 70	500 - 700	C5	160	220	190	0.004	0.007	0.009	0.011	0.013
	H-13, H-21, A-4, 0-2, S-3, etc.	200 - 250	70 - 88	700 - 870	C5	120	170	145	0.004	0.007	0.009	0.011	0.013
S	**High Temp Alloy**	140 - 220	49 - 77	480 - 755	C2	80	105	90	0.004 ❖	0.007	0.009	0.011	0.013
	Hastelloy B, Inconel 600, etc.	220 - 310	77 - 101	755 - 990	C2	60	85	70	0.004 ❖	0.006	0.008	0.010	0.012
	Titanium Alloy	140 - 220	49 - 77	480 - 755	C2	100	125	105	0.004 ❖	0.007	0.009	0.011	0.013
		220 - 310	77 - 101	755 - 990	C2	80	110	90	0.004 ❖	0.006	0.008	0.010	0.012
	Aerospace Alloy	185 - 275	65 - 96	640 - 940	C2	160	210	185	0.007 ❖	0.006	0.011	0.014	0.016
	S82	275 - 350	96 -121	940 - 1180	C2	120	160	140	0.006 ❖	0.008	0.010	0.012	0.014
M	**Stainless Steel 400 Series**	185 - 275	65 - 96	640 - 940	C2	160	210	185	0.007 ❖	0.008	0.011	0.014	0.016
	416, 420, etc.	275 - 350	96 - 121	940 - 1180	C2	120	160	140	0.006 ❖	0.007	0.010	0.012	0.014
	Stainless Steel 300 Series	135 - 185	49 - 65	480 - 640	C2	160	210	185	0.005 ❖	0.007	0.009	0.010	0.012
	304, 316, 17-4PH, etc.	185 - 275	65 - 96	640 - 940	C2	120	160	140	0.004 ❖	0.006	0.008	0.009	0.010
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	C2	80	110	95	0.004 ❖	0.007	0.008	0.009	0.011
		185 - 275	65 - 96	640 - 940	C2	60	80	70	0.003 ❖	0.006	0.007	0.008	0.009

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM TiAlN	SFM TiCN	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8	1-13/32 - 1-7/8
H	**Wear Plate**	400	139	1365	C5	75	115	100	0.003 ❖	0.006	0.008	0.010	0.012
	Hardox, AR400, T-1, etc.	500	160	1600	C5	50	85	70	0.002 ❖	0.005	0.006	0.008	0.010
		600	210	2000	C5	35	75	55	0.001 ❖	0.004	0.005	0.006	0.008
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	C5	110	140	130	0.004 ❖	0.006	0.009	0.011	0.013
		400 - 500	139+	1365+	C5	65	85	75	0.003 ❖	0.005	0.008	0.009	0.011
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	C2, C3	320	460	415	0.008	0.012	0.015	0.019	0.023
		150 - 200	50 - 70	500 - 700	C2, C3	270	400	335	0.007	0.011	0.013	0.017	0.021
		200 - 220	70 - 77	700 - 755	C2, C3	240	360	305	0.006	0.009	0.012	0.015	0.018
		220 - 260	77 - 90	755 - 890	C2, C3	210	310	260	0.005	0.008	0.011	0.013	0.015
		260 - 320	90 - 104	890 - 1020	C2, C3	180	270	225	0.005	0.007	0.010	0.011	0.013
N	**Cast Aluminium**	30	10	100	C2	1200	1500	1330	0.010	0.013	0.018	0.020	0.022
		180	62	600	C2	800	1000	900	0.009	0.013	0.016	0.018	0.020
	Wrought Aluminium	30	10	100	C2	1200	1500	1330	0.004	0.006	0.010	0.012	0.014
		180	62	600	C2	800	1000	900	0.008	0.013	0.014	0.018	0.020
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	C2	275	360	325	0.005	0.008	0.010	0.014	0.017
		200 - 250	68 - 87	670 - 855	C2	210	305	260	0.004	0.007	0.007	0.010	0.013
	Brass	100	38	370	C2	425	600	520	0.006	0.009	0.011	0.015	0.018
	Copper	60	21	200	C2	260	390	325	0.002 ❖	0.003	0.004	0.006	0.010

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

⚠ WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

T-A® Original Recommended Drilling Data | Imperial (inch)

HSS Inserts | Flat Bottom Geometry

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM TiAlN	SFM TiCN	SFM AM200®
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	HSS	170	250	230	290
		150 - 200	50 - 70	500-700	HSS	155	230	205	265
		200 - 250	70 - 88	700-870	HSS	140	210	185	245
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	HSS	150	220	195	255
		125 - 175	46 - 62	450 - 600	HSS	140	210	185	245
		175 - 225	62 - 77	600 - 775	HSS	130	195	175	225
		225 - 275	77 - 96	775 - 940	HSS	120	185	155	215
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	HSS	140	210	185	245
		175 - 225	62 - 77	600 - 775	HSS	130	195	175	225
		225 - 275	77 - 96	775 - 940	HSS	120	185	155	215
		275 - 325	96 - 111	940 - 1090	SC	110	175	150	205
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	HSS	130	185	175	215
		175 - 225	62 - 77	600 - 775	HSS	120	175	155	205
		225 - 275	77 - 96	775 - 940	HSS	110	155	145	180
		275 - 325	96 - 111	940 - 1090	SC	105	145	135	170
		325 - 375	111 - 129	1090 - 1265	SC	95	135	125	155
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	SC	70	95	85	110
		300 - 350	104 - 121	1020 - 1180	SC	50	75	70	90
		350 - 400	121 - 139	1180 - 1365	SC	45	65	60	75
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	HSS	120	170	155	195
		150 - 250	50 - 88	500 - 850	HSS	105	145	135	170
		250 - 350	88 - 121	850 - 1180	SC	85	120	110	140
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	SC	70	95	90	110
		200 - 250	70 - 88	700 - 870	SC	50	80	75	95
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	SC	25	35	30	40
		220 - 310	77 - 101	755 - 990	SC	20	30	25	35
	Titanium Alloy	140 - 220	49 - 77	480 - 755	SC	35	45	40	50
		220 - 310	77 - 101	755 - 990	SC	26	40	35	45
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	SC	65	90	85	110
		275 - 350	96 -121	940 - 1180	SC	50	80	70	90
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	SC	65	90	85	110
		275 - 350	96 - 121	940 - 1180	SC	50	80	70	90
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	SC	65	90	85	110
		185 - 275	65 - 96	640 - 940	SC	50	80	70	90
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	SC	65	90	85	110
		185 - 275	65 - 96	640 - 940	SC	50	80	70	90
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	SC	–	–	–	–
		500	160	1600	SC	–	–	–	–
		600	210	2000	N/A	–	–	–	–
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	SC	45	65	60	80
		400 - 500	139+	1365+	SC	25	40	35	45
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	HSS	150	220	195	255
		150 - 200	50 - 70	500 - 700	HSS	130	195	175	225
		200 - 220	70 - 77	700 - 755	HSS	110	175	150	205
		220 - 260	77 - 90	755 - 890	SC	95	150	125	175
		260 - 320	90 - 104	890 - 1020	SC	80	120	105	140
N	**Cast Aluminium**	30	10	100	HSS	520	750	650	–
		180	62	600	HSS	260	400	350	–
	Wrought Aluminium	30	10	100	HSS	520	750	650	850
		180	62	600	HSS	260	400	350	450
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	SC	130	190	175	230
		200 - 250	68 - 87	670 - 855	SC	95	150	125	165
	Brass	100	38	370	HSS	150	220	190	250
	Copper	60	21	200	SC	115	150	130	170

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

Feed Rate (IPR) by Diameter					
3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8	1-13/32 - 1-7/8	1-29/32 - 2-9/16
0.006	0.009	0.011	0.014	0.016	0.018
0.006	0.009	0.011	0.014	0.016	0.018
0.005	0.009	0.011	0.014	0.015	0.017
0.005 ❖	0.008	0.010	0.013	0.015	0.017
0.005 ❖	0.008	0.010	0.013	0.015	0.016
0.004 ❖	0.007	0.009	0.012	0.014	0.016
0.004 ❖	0.007	0.009	0.012	0.014	0.015
0.005	0.008	0.010	0.013	0.015	0.018
0.004	0.007	0.009	0.012	0.014	0.017
0.004	0.007	0.009	0.012	0.014	0.017
0.004	0.006	0.008	0.010	0.013	0.015
0.005	0.007	0.009	0.012	0.013	0.016
0.004	0.007	0.009	0.012	0.013	0.016
0.004	0.006	0.009	0.012	0.013	0.016
0.004	0.005	0.008	0.010	0.012	0.015
0.003	0.005	0.008	0.010	0.012	0.014
0.004 ❖	0.006	0.008	0.009	0.010	0.012
0.003 ❖	0.006	0.008	0.009	0.010	0.012
0.003 ❖	0.005	0.007	0.008	0.009	0.011
0.005 ❖	0.009	0.010	0.012	0.015	0.017
0.004 ❖	0.008	0.009	0.010	0.013	0.016
0.004 ❖	0.007	0.008	0.009	0.012	0.015
0.004	0.005	0.007	0.009	0.010	0.012
0.004	0.005	0.007	0.009	0.009	0.011
0.003 ❖	0.006	0.007	0.009	0.010	0.012
0.003 ❖	0.005	0.006	0.007	0.008	0.010
0.003 ❖	0.006	0.007	0.009	0.010	0.012
0.003 ❖	0.005	0.006	0.007	0.008	0.010
0.005 ❖	0.007	0.008	0.010	0.012	0.015
0.004 ❖	0.006	0.007	0.009	0.010	0.012
0.005 ❖	0.007	0.008	0.010	0.012	0.014
0.004 ❖	0.006	0.007	0.009	0.010	0.011
0.005 ❖	0.007	0.008	0.010	0.012	0.014
0.004 ❖	0.006	0.007	0.009	0.010	0.011
0.005 ❖	0.007	0.008	0.010	0.012	0.014
0.004 ❖	0.006	0.007	0.009	0.010	0.011
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
0.003 ❖	0.005	0.007	0.008	0.011	0.015
0.002 ❖	0.004	0.006	0.007	0.009	0.011
0.007	0.012	0.016	0.020	0.024	0.027
0.006	0.011	0.014	0.018	0.022	0.025
0.006	0.009	0.012	0.016	0.018	0.021
0.005	0.007	0.009	0.012	0.014	0.017
0.004	0.006	0.007	0.009	0.012	0.014
0.007	0.011	0.014	0.017	0.018	0.019
0.007	0.011	0.014	0.016	0.017	0.019
0.007	0.011	0.014	0.017	0.018	0.019
0.007	0.011	0.014	0.016	0.017	0.019
0.005	0.009	0.012	0.016	0.020	0.024
0.004	0.006	0.008	0.010	0.012	0.015
0.006	0.010	0.014	0.017	0.021	0.025
0.002 ❖	0.003	0.006	0.008	0.010	0.014

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

⚠ WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

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T-A® Original Recommended Drilling Data | Imperial (inch)

Carbide Inserts | Flat Bottom Geometry

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM TiAlN	SFM TiCN	SFM AM200®	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	13/32 - 1-7/8
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38 - 50	370-500	C2	270	380	325	425	0.007	0.010	0.013	0.015
		150 - 200	50 - 70	500-700	C2	240	320	280	375	0.006	0.009	0.012	0.014
		200 - 250	70 - 88	700-870	C2	220	300	260	350	0.005	0.009	0.011	0.013
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30 - 46	300-450	C2	260	345	315	410	0.007 ❖	0.009	0.011	0.014
		125 - 175	46 - 62	450 - 600	C2	220	300	260	350	0.006 ❖	0.009	0.011	0.014
		175 - 225	62 - 77	600 - 775	C2	200	280	235	320	0.005 ❖	0.008	0.010	0.013
		225 - 275	77 - 96	775 - 940	C2	180	240	215	285	0.004 ❖	0.008	0.010	0.013
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46 - 62	450 - 600	C2	220	300	260	350	0.006	0.009	0.011	0.014
		175 - 225	62 - 77	600 - 775	C2	200	280	240	320	0.005	0.008	0.010	0.013
		225 - 275	77 - 96	775 - 940	C2	180	240	210	285	0.005	0.008	0.010	0.013
		275 - 325	96 - 111	940 - 1090	C2	150	210	180	240	0.004	0.007	0.009	0.012
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46 - 62	450 - 600	C2	215	290	250	340	0.006	0.009	0.011	0.014
		175 - 225	62 - 77	600 - 775	C2	200	270	230	320	0.005	0.008	0.010	0.013
		225 - 275	77 - 96	775 - 940	C2	180	230	205	290	0.005	0.008	0.010	0.013
		275 - 325	96 - 111	940 - 1090	C2	175	215	190	280	0.004	0.007	0.009	0.012
		325 - 375	111 - 129	1090 - 1265	C2	145	190	170	230	0.003	0.006	0.009	0.011
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77 - 104	600 - 1020	C2	140	170	160	220	0.005 ❖	0.008	0.009	0.010
		300 - 350	104 - 121	1020 - 1180	C2	120	160	140	190	0.004 ❖	0.007	0.008	0.009
		350 - 400	121 - 139	1180 - 1365	C2	100	145	120	160	0.003 ❖	0.006	0.007	0.009
	Structural Steel A36, A285, A516, etc.	100 - 150	38 - 50	370 - 500	C2	205	265	240	325	0.007 ❖	0.009	0.012	0.014
		150 - 250	50 - 88	500 - 850	C2	170	215	200	270	0.005 ❖	0.009	0.010	0.012
		250 - 350	88 - 121	850 - 1180	C2	155	200	180	240	0.004 ❖	0.008	0.009	0.010
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50 - 70	500 - 700	C2	140	190	160	220	0.003	0.006	0.008	0.009
		200 - 250	70 - 88	700 - 870	C2	100	150	120	160	0.003	0.006	0.008	0.009
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49 - 77	480 - 755	C2	70	90	80	110	0.003 ❖	0.006	0.008	0.009
		220 - 310	77 - 101	755 - 990	C2	50	70	60	80	0.003 ❖	0.005	0.007	0.009
	Titanium Alloy	140 - 220	49 - 77	480 - 755	C2	85	110	90	130	0.003 ❖	0.005	0.006	0.008
		220 - 310	77 - 101	755 - 990	C2	70	95	80	100	0.003 ❖	0.004	0.005	0.007
	Aerospace Alloy S82	185 - 275	65 - 96	640 - 940	C2	140	120	165	130	0.006 ❖	0.006	0.010	0.012
		275 - 350	96 -121	940 - 1180	C2	110	90	125	105	0.005 ❖	0.005	0.009	0.010
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65 - 96	640 - 940	C2	140	180	165	210	0.006 ❖	0.008	0.010	0.012
		275 - 350	96 - 121	940 - 1180	C2	110	140	125	160	0.005 ❖	0.007	0.009	0.010
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49 - 65	480 - 640	C2	90	120	110	130	0.005 ❖	0.007	0.008	0.010
		185 - 275	65 - 96	640 - 940	C2	70	90	80	105	0.004 ❖	0.006	0.007	0.009
	Super Duplex Stainless Steel	135 - 185	49 - 65	480 - 640	C2	70	95	85	110	0.004 ❖	0.006	0.007	0.008
		185 - 275	65 - 96	640 - 940	C2	55	70	60	85	0.003 ❖	0.005	0.006	0.007

❖ Contact our Application Engineering department for assistance when machining these materials

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

ISO	Material	Hardness (BHN)	Hardness kg	Hardness N/mm²	Carbide Grade	SFM TiN	SFM TiAlN	SFM TiCN	SFM AM200®	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	13/32 - 1-7/8
H	**Wear Plate**	400	139	1365	C2	65	100	85	130	0.003 ❖	0.004	0.006	0.008
	Hardox, AR400, T-1, etc.	500	160	1600	C2	45	75	60	100	0.002 ❖	0.003	0.005	0.006
		600	210	2000	C2	35	65	45	80	0.001 ❖	0.002	0.004	0.005
	Hardened Steel	300 - 400	104 - 139	1020 - 1365	C2	100	125	110	135	0.004 ❖	0.006	0.007	0.009
		400 - 500	139+	1365+	C2	60	75	65	110	0.003 ❖	0.005	0.06	0.007
K	**Nodular, Grey, Ductile Cast Iron**	120 - 150	44 - 50	430 - 500	C2	270	405	360	450	0.007	0.010	0.013	0.016
		150 - 200	50 - 70	500 - 700	C2	230	350	290	390	0.006	0.009	0.011	0.014
		200 - 220	70 - 77	700 - 755	C2	200	320	260	350	0.005	0.008	0.010	0.013
		220 - 260	77 - 90	755 - 890	C2	180	270	220	300	0.004	0.007	0.009	0.011
		260 - 320	90 - 104	890 - 1020	C2	160	240	200	265	0.004	0.006	0.009	0.009
N	**Cast Aluminium**	30	10	100	C2	520	750	650	–	0.009	0.013	0.016	0.017
		180	62	600	C2	260	400	350	–	0.008	0.012	0.014	0.015
	Wrought Aluminium	30	10	100	C2	950	1200	1070	1270	0.005	0.007	0.009	0.010
		180	62	600	C2	630	800	715	850	0.004	0.006	0.008	0.009
	Aluminium Bronze	100 - 200	38 - 68	370 - 670	C2	240	310	280	340	0.004	0.006	0.008	0.011
		200 - 250	68 - 87	670 - 855	C2	180	265	220	285	0.003	0.005	0.006	0.008
	Brass	100	38	370	C2	370	520	450	600	0.005	0.006	0.008	0.012
	Copper	60	21	200	C2	220	345	280	380	0.002 ❖	0.002	0.003	0.005

❖ Contact our Application Engineering department for assistance when machining these materials

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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)

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

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T-A® Original Recommended Drilling Data | Imperial (inch)

Carbide Inserts | Diamond Coating

	Material	Carbide Grade	SFM  Diamond Coating	Feed Rate (IPR) by Diameter 3/8 - 1/2	33/64 - 11/16	45/64 - 15/16	31/32 - 1-3/8
Polymer Matrix Composites	Carbon (hard)	N2	1000 - 1500	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Carbon Fibre	N2	1000 - 1500	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Carbon / Glass Fibre	N2	1000 - 1500	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Fibreglass	N2	1000 - 1500	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Graphite	N2	1000 - 1500	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Plastics	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Epoxy Resin	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Bismaleimide Resin	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Polyester Resin	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Phenolic Resin	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Rubber	N2	250 - 1000	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
Metal Matrix Composites	Aluminium	N2	1000	0.008	0.013	0.016	0.020
	Si < 10%	N2	1000	0.008	0.013	0.016	0.020
	10% < Si < 15%	N2	850 - 1000	0.008	0.013	0.016	0.020
	15% < SI < 20%	N2	650 - 850	0.008	0.013	0.016	0.020
	20% < Si < 25%	N2	500 - 650	0.008	0.013	0.016	0.020
	25% < Si	N2	200 - 500	0.008	0.013	0.016	0.020
	Brass	N2	250 - 500	0.008	0.013	0.016	0.020
	Bronze	N2	250 - 500	0.008	0.013	0.016	0.020
	Copper	N2	100 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Copper Alloys	N2	100 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Lead Alloys	N2	100 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Magnesium Alloys	N2	100 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Precious Metals	N2	100 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
Ceramic Matrix Composites	Carbide (green)	N2	50 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Ceramic (green)	N2	50 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014
	Ceramic (pre-sintered)	N2	50 - 250	0.004 - 0.006	0.008 - 0.010	0.010 - 0.012	0.012 - 0.014

Deep Hole Drilling Speed and Feed Adjustment

	⚠ Holder Length				
	Extended	Long	Long Plus	XL	3XL
Speed	0.90	0.85	0.80	0.80	0.75
Feed	–	0.95	0.90	0.90	0.90

Recommended Speed and Feed Example

If the recommended speed and feed is 200 SFM and 0.008 IPR for a standard length holder, then the speed and feed using a 3XL holder in the same application would be 150 SFM and 0.007 IPR.

200 • 0.75 = 150 SFM	0.008 • 0.90 = 0.007 IPR

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

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IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is available through our Application Engineering department. See adjustment examples on the following page.

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
7/16 - 20	W	0.3860	79%	0.003"	0.3890"	75%
7/16 - 20	25/64"	0.3906	72%	0.003"	0.3936"	68%
1/2 - 13	10.5mm	0.4134	87%	0.003"	0.4164"	84%
1/2 - 13	27/64"	0.4219	78%	0.003"	0.4249"	75%
1/2 - 13	7/16"	0.4375	63%	0.003"	0.4405"	60%
1/2 - 20	29/64"	0.4531	72%	0.003"	0.4561"	68%
9/16 - 12	15/32"	0.4688	87%	0.003"	0.4718"	84%
9/16 - 12	12.0mm	0.4724	72%	0.003"	0.4874"	69%
9/16 - 12	31/64"	0.4844	83%	0.003"	0.4754"	80%
9/16 - 18	1/2"	0.5000"	87%	0.003"	0.5030"	82%
9/16 - 18	13.0mm	0.5118"	70%	0.003"	0.5148"	66%
9/16 - 18	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%
5/8 - 18	14.5mm	0.5709"	75%	0.003"	0.5739"	75%
5/8 - 18	37/64"	0.5781"	65%	0.003"	0.5811"	70%
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%
3/4 - 10	16.5mm	0.6496"	77%	0.003"	0.6526"	75%
3/4 - 10	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%
3/4 - 16	17.5mm	0.6890"	75%	0.003"	0.6920"	71%
7/8 - 9	49/64"	0.7656"	76%	0.003"	0.7686"	74%
7/8 - 9	25/32"	0.7813"	65%	0.003"	0.7843"	63%
7/8 - 14	51/64"	0.7969"	84%	0.003"	0.7999"	81%
7/8 - 14	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%
1 - 8	7/8"	0.8750"	77%	0.003"	0.8780"	75%
1 - 8	57/64"	0.8906"	67%	0.003"	0.8936"	65%
1 - 12	29/32"	0.9063"	87%	0.003"	0.9093"	84%
1 - 12	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%
1-1/8 - 12	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%
24 x 2	7/8"	0.8750"	68%	0.075mm	22.30mm	65%
27 x 3	24.0mm	0.9449"	77%	0.075mm	24.08mm	75%

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:

$$\text{\% Thread} = \text{\# of Thread per Inch} \left[\frac{\text{Basic Major Diameter of Thread} - \text{Drill Hole Size}}{0.0130} \right]$$

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 • K_m**
   where:
   Thrust = axial thrust (lbs)
   IPR = feed rate (in/rev)
   DIA = diameter of drill (inch)
   K_m = specific cutting energy (lbs/in^2)

5. **Tool Power = .6283 • IPR • RPM • K_m • DIA^2**
   where:
   Tool Power = tool power (HP)
   IPR = feed rate (in/rev)
   RPM = revolutions per minute (rev/min)
   K_m = specific cutting energy (lbs/in^2)
   DIA = diameter of drill (inch)

Material Constants

Type of Material	Hardness	K_m (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
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
Titanium Alloy	–	0.72
Aluminium 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 requirements.
- 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*.

Coolant Recommendations | Imperial (inch)

HSS Drill Inserts

ISO	Material	Pressure or Flow Rate	3/8 - 1/2	33/64 - 11/16	23/32 - 1	1 - 1-1/4	1-1/4 - 2	2 - 3	3 - 4
P	**Free Machining Steel**	PSI	175 - 185	100 - 120	105 - 140	80 - 115	75 - 100	40 - 50	65 - 90
	1118, 1215, 12L14, etc.	GPM	2.5 - 2.6	2.8 - 3.0	4.4 - 5.2	7 - 8	12 - 14	30 - 33	38 - 44
	Low Carbon Steel	PSI	165 - 170	75 - 90	75 - 95	60 - 80	55 - 75	30 - 40	50 - 65
	1010, 1020, 1025, 1522, 1144, etc.	GPM	2.4 - 2.5	2.4 - 2.6	3.7 - 4.2	6 - 7	11 - 12	26 - 30	33 - 38
	Medium Carbon Steel	PSI	160 - 165	70 - 85	70 - 90	55 - 75	50 - 70	30 - 40	50 - 65
	1030, 1040, 1050, 1527, 1140, 1151, etc.	GPM	2.3 - 2.4	2.3 - 2.6	3.7 - 4.2	5 - 6	10 - 12	26 - 30	33 - 38
	Alloy Steel	PSI	160 - 165	65 - 75	65 - 80	50 - 70	45 - 60	30 - 35	40 - 50
	4140, 5140, 8640, etc.	GPM	2.3 - 2.4	2.2 - 2.4	3.5 - 3.9	5 - 6	10 - 11	26 - 28	30 - 33
	High Strength Alloy	PSI	150 - 155	55 - 60	45 - 50	25 - 30	25 - 30	20 - 25	40 - 50
	4340, 4330V, 300M, etc.	GPM	2.3 - 2.4	2.1 - 2.2	2.9 - 3.1	4 - 5	7 - 8	21 - 23	23 - 26
	Structural Steel	PSI	160 - 165	75 - 85	65 - 80	40 - 55	40 - 50	25 - 30	40 - 50
	A36, A285, A516, etc.	GPM	2.3 - 2.4	2.4 - 2.6	3.5 - 3.9	5 - 6	9 - 10	23 - 26	30 - 33
	Tool Steel	PSI	150 - 155	55 - 60	45 - 50	25 - 30	25 - 30	20 - 25	25 - 30
	H-13, H-21, A-4, 0-2, S-3, etc.	GPM	2.3 - 2.4	2.1 - 2.2	2.9 - 3.1	4 - 5	7 - 8	21 - 23	23 - 26
S	**High Temp Alloy**	PSI	150 - 155	60 - 65	50 - 55	30 - 35	25 - 30	25 - 30	44
	Hastelloy B, Inconel 600, etc.	GPM	2.3 - 2.4	2.2 - 2.3	3.1 - 3.2	4 - 5	7 - 8	23 - 26	33
	Titanium Alloy	PSI	150 - 155	60 - 65	50 - 55	30 - 35	25 - 30	25 - 30	44
		GPM	2.3 - 2.4	2.2 - 2.3	3.1 - 3.2	4 - 5	7 - 8	23 - 26	33
	Aerospace Alloy	PSI	150 - 155	60 - 65	50 - 55	30 - 35	25 - 30	25 - 30	44
	S82	GPM	2.3 - 2.4	2.2 - 2.3	3.1 - 3.2	4 - 5	7 - 8	23 - 26	33
M	**Stainless Steel 400 Series**	PSI	171	86	75	55	51	29	45
	416, 420, etc.	GPM	3	3	4	6	10	26	31
	Stainless Steel 300 Series	PSI	171	86	75	55	51	29	45
	304, 316, 17-4PH, etc.	GPM	3	3	4	6	10	26	31
	Super Duplex Stainless Steel	PSI	171	86	75	55	51	29	45
		GPM	3	3	4	6	10	26	31
H	**Wear Plate**	PSI	155	61	51	29	29	25	29
	Hardox, AR400, T-1, etc.	GPM	2	2	3	5	8	23	26
	Hardened Steel	PSI	155	61	51	29	29	25	29
		GPM	2	2	3	5	8	23	26
K	**SG / Nodular Cast Iron**	PSI	160	65	61	41	35	29	35
		GPM	2	2	3	5	9	26	28
	Grey / White Iron	PSI	160	65	61	41	35	29	35
		GPM	2	2	3	5	9	26	28
N	**Cast Aluminium**	PSI	210	180	230	159	125	51	80
		GPM	3	4	6	9	16	33	42
	Wrought Aluminium	PSI	210	180	230	159	125	51	80
		GPM	3	4	6	9	16	33	42
	Aluminium Bronze	PSI	186	120	140	115	100	51	90
		GPM	2.5	3	5	8	14	33	44
	Brass	PSI	159	65	61	41	35	29	35
		GPM	2	2	3	5	9	26	28
	Copper	PSI	186	120	140	115	100	51	90
		GPM	2.5	3	5	8	14	33	44

Deep Hole Drilling Coolant Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Pressure and Flow	1.3	1.5	2	2	3

Recommended Coolant Example

If the recommended pressure and flow is 150 PSI and 2.4 GPM for a standard length holder, then the adjusted pressure and flow for a 3XL holder would be 450 PSI and 7.2 GPM.

150 • 3 = 450 PSI	2.4 • 3 = 7.2 GPM

⚠ WARNING **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holder more than 50 RPM unless it is engaged with the workpiece or fixture.

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IMPORTANT: The coolant pressure and flow rate recommendations above represent a good approximation to obtain optimum tool life and chip evacuation at Allied Machine recommended speeds and feeds. If lower coolant capabilities exist in a drilling application, the T-A® drilling system will still function at reduced penetration rates. Contact our Application Engineering department for a more specific recommendation of coolant requirements and/or speeds and feeds.

Coolant Recommendations | Imperial (inch)

Carbide Drill Inserts

ISO	Material	Pressure or Flow Rate	3/8 - 1/2	33/64 - 11/16	23/32 - 1	1 - 1-3/8	1-13/32 - 1-7/8
P	**Free Machining Steel**	PSI	195	140	160	140	155
	1118, 1215, 12L14, etc.	GPM	2.6	3.3	5.5	9	18
	Low Carbon Steel	PSI	180	105	105	110	115
	1010, 1020, 1025, 1522, 1144, etc.	GPM	2.5	2.9	4.4	8	15
	Medium Carbon Steel	PSI	175	100	90	70	75
	1030, 1040, 1050, 1527, 1140, 1151, etc.	GPM	2.5	2.8	4.1	7	13
	Alloy Steel	PSI	165	85	100	75	70
	4140, 5140, 8640, etc.	GPM	2.4	2.6	4.3	6	12
	High Strength Alloy	PSI	175	115	105	75	70
	4340, 4330V, 300M, etc.	GPM	2.4	2.3	3.2	5	8
	Structural Steel	PSI	175	115	105	75	70
	A36, A285, A516, etc.	GPM	2.5	3.0	4.4	6	12
	Tool Steel	PSI	155	60	55	40	35
	H-13, H-21, A-4, 0-2, S-3, etc.	GPM	2.4	2.2	3.2	5	8
S	**High Temp Alloy**	PSI	247	160	174	160	130
	Hastelloy B, Inconel 600, etc.	GPM	3	4	6	9	16
	Titanium Alloy	PSI	247	160	174	160	130
		GPM	3	4	6	9	16
	Aerospace Alloy	PSI	247	160	174	160	130
	S82	GPM	3	4	6	9	16
M	**Stainless Steel 400 Series**	PSI	329	239	260	250	190
	416, 420, etc.	GPM	3	4	7	12	20
	Stainless Steel 300 Series	PSI	329	239	260	250	190
	304, 316, 17-4PH, etc.	GPM	3	4	7	12	20
	Super Duplex Stainless Steel	PSI	329	239	260	250	190
		GPM	3	4	7	12	20
H	**Wear Plate**	PSI	210	75	70	49	45
	Hardox, AR400, T-1, etc.	GPM	3	2	4	5	10
	Hardened Steel	PSI	210	75	70	49	45
		GPM	3	2	4	5	10
K	**SG / Nodular Cast Iron**	PSI	225	104	90	90	80
		GPM	3	3	4	7	13
	Grey / White Iron	PSI	225	104	90	90	80
		GPM	3	3	4	7	13
N	**Cast Aluminium**	PSI	350	319	315	284	200
		GPM	4	5	8	12	20
	Wrought Aluminium	PSI	350	319	315	284	200
		GPM	4	5	8	12	20
	Aluminium Bronze	PSI	290	239	239	220	174
		GPM	3	4	7	11	19
	Brass	PSI	350	319	315	284	200
		GPM	4	5	7	12	20
	Copper	PSI	290	239	239	220	174
		GPM	3	4	7	11	19

Deep Hole Drilling Coolant Adjustment

	⚠ Holder Length				
	Extended	**Long**	**Long Plus**	**XL**	**3XL**
Pressure and Flow	1.3	1.5	2	2	3

Recommended Coolant Example

If the recommended pressure and flow is 150 PSI and 2.4 GPM for a standard length holder, then the adjusted pressure and flow for a 3XL holder would be 450 PSI and 7.2 GPM.

150 • 3 = 450 PSI	2.4 • 3 = 7.2 GPM

⚠ **WARNING** **Tool failure can cause serious injury. To prevent:**

- When using holders without support bushing, use a short T-A® holder to establish an initial hole that is a minimum of 2 diameters deep.
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IMPORTANT: The coolant pressure and flow rate recommendations above represent a good approximation to obtain optimum tool life and chip evacuation at Allied Machine recommended speeds and feeds. If lower coolant capabilities exist in a drilling application, the T-A® drilling system will still function at reduced penetration rates. Contact our Application Engineering department for a more specific recommendation of coolant requirements and/or speeds and feeds.

Troubleshooting Guide

	Potential Problem																						
	Accelerated corner wear	Barber pole	Bell mouth hole	Insert chipping	Blue chips	Build 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	Notching of insert	Oversize hole	Poor hole finish	Poor tool life	Power spikes - Load meter	Retract spiral	Step burned on insert	
Setup Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	**Possible Solutions**
⚠ Use of Standard, Standard Plus, Extended, Long, Long Plus, XL, and 3XL holders. See page 148 for Deep Hole Drilling guidelines.		2	3				7		9				13	14			17				21		• Start with short holder and drill a minimum depth equal to 2xD (see page # for instructions). • Spot hole with stub tool of same or greater included angle as T-A® drill insert. • Decrease feed a minimum of 50% until establishing full diameter. • Use special holder with wear pads or chrome bearing area to work with drill bushings.
Starting on an inclined surface.							7		9	10	11		13		15						21		• Spot face surface to provide a flat entry surface. • Spot hole with stub tool of same or greater included angle as T-A® drill insert. • Decrease feed a minimum of 50% until establishing full diameter. • Use special holder with wear pads or chrome bearing area to work with drill bushings.
Worn or misaligned spindle (lathe, screw machine, chucker).	1		3				7		9	10	11		13				17	18			21		• Align spindle and turret or tailstock. • Repair spindle. • Spot hole with stub tool of same or greater included angle as T-A® drill insert.
Use of low rigidity machine tools (radial drills, multi-spindle drill press, etc.).		2	3	4			7		9	10			13	14							21		• Spot hole with stub tool of same or greater included angle as T-A® drill insert. • 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). • Use special holder with wear pads or chrome bearing area to work with drill bushings. • Use tougher tool steel grades with high wear resistant coatings.
Poor work piece support.		2		4			7			10	11				15			18			21		• 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). • Use tougher tool steel grades with high wear resistant coatings.
Flood coolant, low coolant pressure or low coolant volume.	1				5	6		8		10		11					17	18	18	20		21	• Run through coolant tool holder when drilling greater than one times diameter. • 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.

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

Visit **www.alliedmachine.com** for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering Team.

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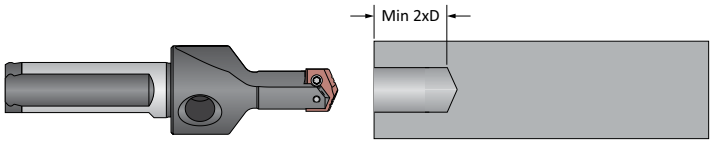
	Accelerated corner wear	Barber pole	Bell mouth hole	Insert chipping	Blue chips	Build Up Edge (BUE)	Chatter	Chip packing	Chipping of point	Damaged or broken tools	Excessive margin wear	High flank wear	Hole lead off	Hole out of position	Hole out of round	Notching of insert	Oversize hole	Poor hole finish	Poor tool life	Power spikes - Load meter	Retract spiral	Step burned on insert	
Setup Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	**Possible Solutions**
Interrupted cuts. Entry or exit surfaces that are not perpendicular to the spindle (draft angles, stepped surfaces, cross holes, and cast or forged surfaces).				4			7		9	10	11		13	14	15		17	18	19				• Pre-mill (spot face) entry or exit surface to remove interruption. • Spot hole with stub tool of same or greater included angle as T-A® drill insert. • 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 speeds.	1				5	6				10		12							19			22	• Reduce speed if a step is worn in the insert, calculate SFM at the worn diameter. Reduce this value by 10% and apply this new value to the original tool diameter. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance. • Select an insert grade (premium, super cobalt, or carbide) or coating (TiAlN, TiCN, or AM200®) that is more wear and heat resistant.
Poor material micro-structure or foreign particles (forgings and castings that have not been normalised or annealed, poorly prepared steel, flame cut parts and sand casting).				4		6				10		12	13			16			19				• Compare performance of other tools for similar wear problems, which may indicate poor micro-structure. Anneal or normalise parts to improve micro-structure for machining. • To improve tool life in materials with poor micro-structure, try carbide grades. • For hard spots or inclusions, use the tougher insert steel grade with high wear resistant coatings (TiAlN, TiCN, AM200®). • Reduce feeds (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Poor chip control.								8		10	11		13				17	18	19	20			• Increase feed to recommended levels. Contact Allied Application Engineering team for technical recommendations. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance. • See pages 4-5 for special purpose geometries.
Spot drilled holes with included angle less than that matching T-A® or cored holes.	1			4			7						13			16			19				• Spot hole with short tool of same or greater included angle as T-A® drill insert. • Reduce feed (**NOTICE:** Do not reduce feed below threshold of good chip formation) • If possible, drill from solid.
Use of high wear resistant insert grades.				4						10													• Use tougher grade of T-A® (from carbide to cobalt to HSS). See wear versus toughness chart on page #. • Increase rigidity of setup.

Deep Hole Drilling Guidelines

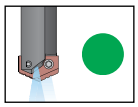
For Lengths greater than 9xD (including Extended, Long, XL, 3XL, and Special Length)

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.
Utilise a pilot drill with the same or larger included point angle.

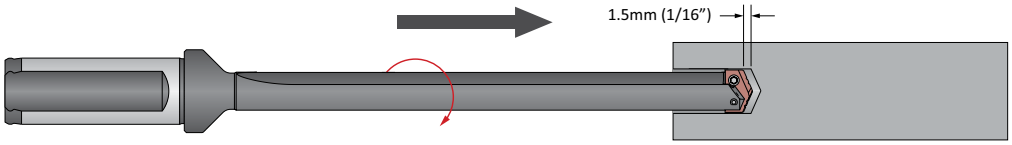


Coolant ON

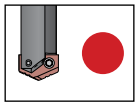


2. Feed-in ⚠
50 RPM max
300 mm/min (12 IPM)

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.

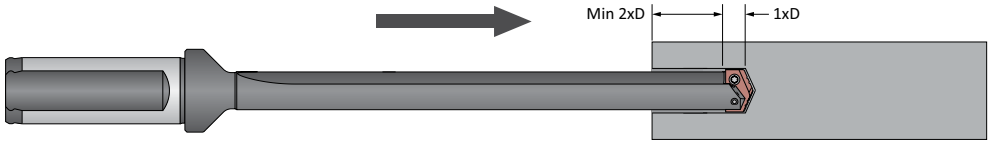


Coolant OFF

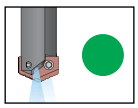


3. Deep Hole Transition Drilling
50 % RPM
75% mm/rev (IPR)

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

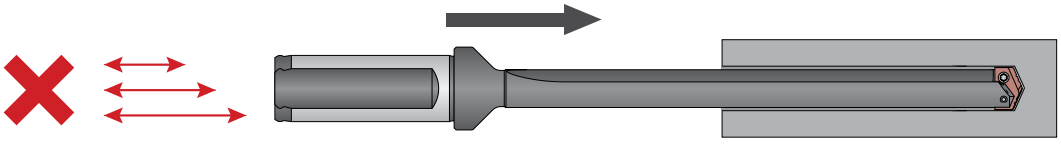


Coolant ON

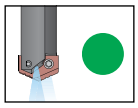


4. Deep Hole Drilling - Blind
100% RPM
100% mm/rev (IPR)

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

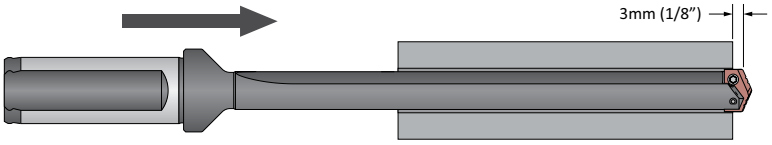


Coolant ON



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.



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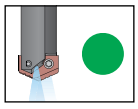
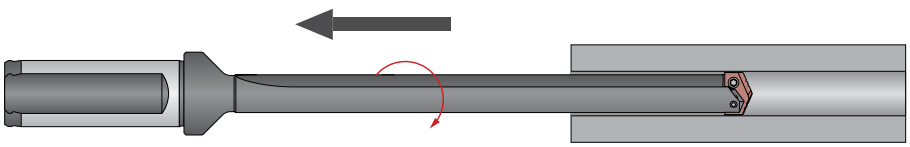


6. Drill Retract ⚠
50 RPM max

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



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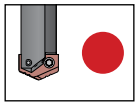

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