Competitive Test Results

GEN3SYS®XT Pro

The GEN3SYS®XT Pro drilling system is designed to provide optimal results in each specific ISO material class.
This allows the XT Pro to outperform the competition no matter what material you're drilling.
Let's take a look at some real world test results for the GEN3SYS®XT Pro drilling system.

P **Average Tool Life:**
Test results drilling in 4150 steel

Hole Diameter	Depth of Cut	Coolant	Speed	Feed
19mm (0.748")	38.1mm (1-1/2")	21 BAR	1583 RPM	563 mm/min (22.16 inch/min)

Competitor 1

25000

50000

62941 total linear mm

Competitor 2

25000

50000

75000

84251 total linear mm

XT Pro Insert with XT Pro Holder

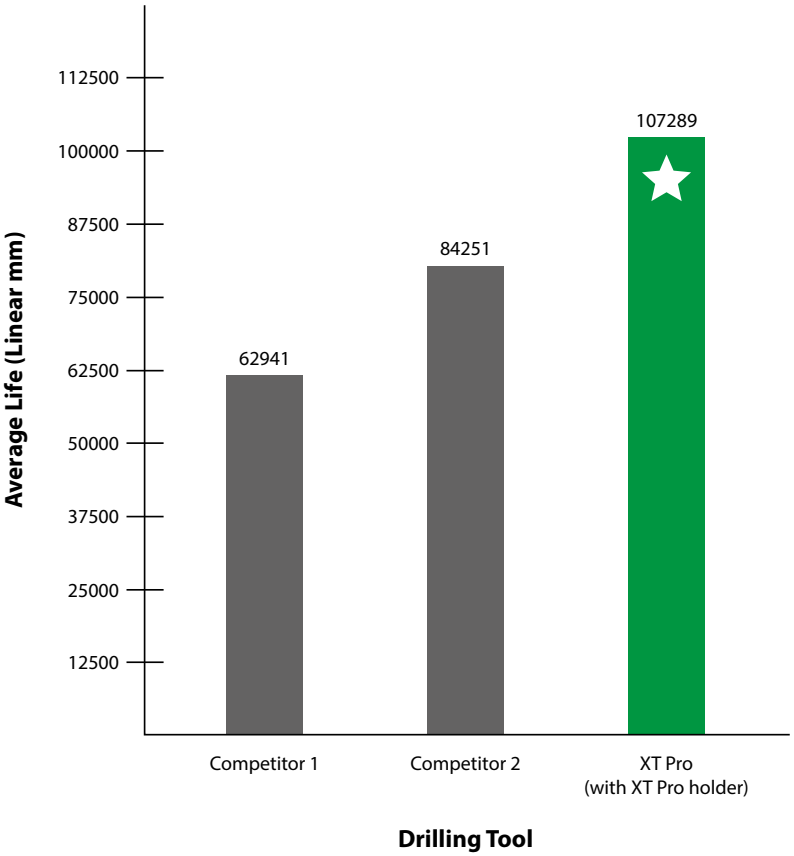
25000

50000

75000

100000

107289 total linear mm

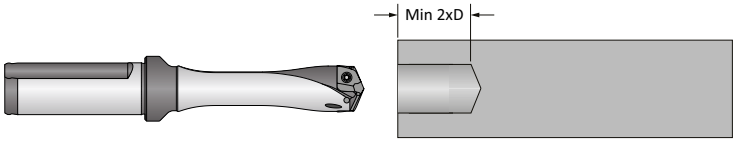


Deep Hole Drilling Guidelines

GEN3SYS®XT Pro | 10xD Holders

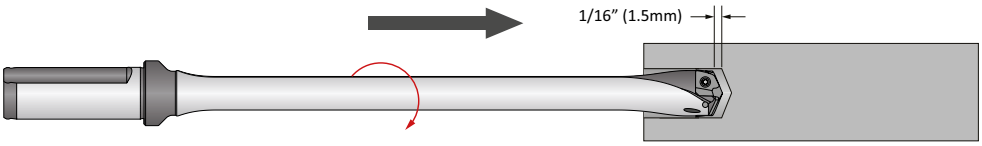
1. Pilot Hole
100 % RPM
100% mm/rev (IPR)

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



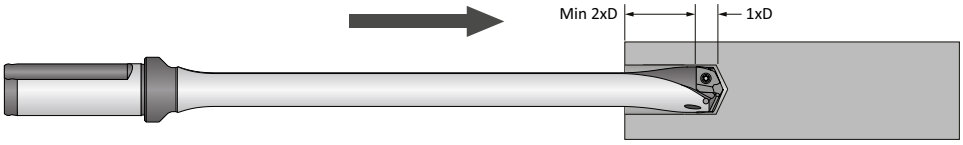
2. Feed-in
50 RPM max
300 mm/min (12 IPM)

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.



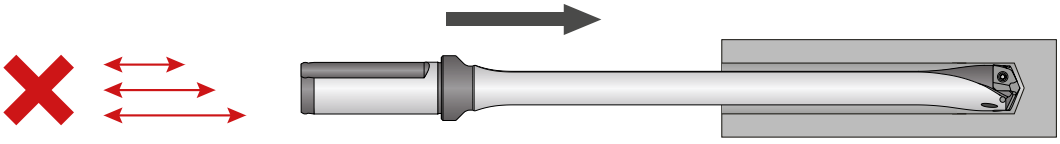
3. Deep Hole Transition Drilling
50 % RPM
75% mm/rev (IPR)

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



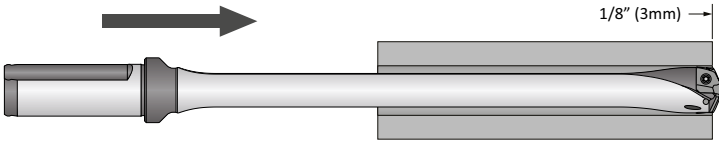
4. Deep Hole Drilling - Blind
100% RPM
100% mm/rev (IPR)

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



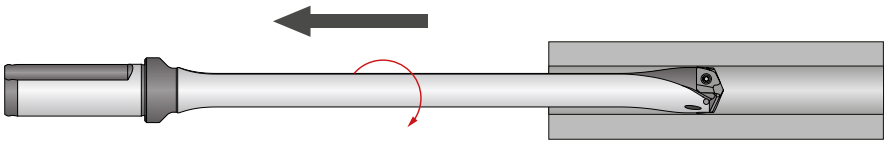
5. Deep Hole Drilling - at Breakout
50% RPM
75% mm/rev (IPR)

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.



6. Drill Retract
50 RPM max

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



⚠ WARNING **Tool failure can cause serious injury. To prevent:**
- When using holders without support bushing, use a short GEN3SYS® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holders more than 50 RPM unless it is engaged with the workpiece or fixture.

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

Recommended Drilling Data | Metric (mm)

ISO	Material	Hardness BHN	Hardness kg	Hardness N/mm²	Speed (M/mm)	Feed Rate (mm/rev) by Diameter: 11 series 11.00 - 11.99	12 series 12.00 - 12.99	13 series 13.00 - 13.99	14 series 14.00 - 14.99
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38-50	370-500	168	0.28	0.30	0.33	0.36
		150 - 200	50-70	500-700	145	0.25	0.28	0.30	0.33
		200 - 250	70-88	700-870	130	0.20	0.23	0.25	0.28
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30-46	300-450	158	0.28	0.30	0.33	0.36
		125 - 175	46-62	450-600	137	0.25	0.28	0.30	0.33
		175 - 225	62-77	600-775	125	0.23	0.25	0.28	0.30
		225 - 275	77-96	775-940	107	0.18	0.20	0.23	0.25
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46-62	450-600	137	0.25	0.28	0.30	0.33
		175 - 225	62-77	600-775	125	0.23	0.25	0.28	0.30
		225 - 275	77-96	775-940	107	0.20	0.23	0.25	0.28
		275 - 325	96-111	940-1090	91	0.18	0.20	0.23	0.25
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	42-62	450-600	126	0.25	0.28	0.30	0.33
		175 - 225	62-77	600-775	116	0.23	0.25	0.28	0.30
		225 - 275	77-96	775-940	104	0.20	0.23	0.25	0.28
		275 - 325	96-111	940-1090	94	0.15	0.18	0.20	0.23
		325 - 375	111-129	1090-1265	85	0.15	0.15	0.18	0.20
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77-104	600-1020	76	0.20	0.23	0.25	0.28
		300 - 350	104-121	1020-1180	69	0.15	0.18	0.20	0.23
		350 - 400	121-139	1180-1365	61	0.13	0.18	0.18	0.20
	Structural Steel A36, A285, A516, etc.	100 - 150	38-50	370-500	125	0.25	0.28	0.30	0.33
		150 - 250	50-88	500-850	101	0.20	0.23	0.25	0.28
		250 - 350	88-121	850-1180	93	0.18	0.20	0.23	0.25
	Tool Steel H-13, H-21, A-4, 0-2, S-3, etc.	150 - 200	50-70	500-700	81	0.15	0.18	0.18	0.20
		200 - 250	70-88	700-870	62	0.13	0.15	0.15	0.18
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49-77	480-755	40	0.15	0.18	0.18	0.20
		220 - 310	77-101	755-990	30	0.13	0.15	0.15	0.18
	Titanium Alloy	140 - 220	49-77	480-755	43	0.13	0.15	0.18	0.20
		220 - 310	77-101	755-990	34	0.10	0.13	0.15	0.18
	Aerospace Alloy S82	185 - 275	65-96	640-940	50	0.10	0.10	0.12	0.14
		275 - 350	96-121	940-1180	41	0.09	0.09	0.10	0.12
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65-96	640-940	73	0.15	0.18	0.18	0.20
		275 - 350	96-121	940-1180	56	0.13	0.15	0.15	0.18
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49-65	480-640	67	0.10	0.13	0.13	0.15
		185 - 275	65-96	640-940	49	0.08	0.10	0.10	0.13
	Super Duplex Stainless Steel	135 - 185	49-65	480-640	38	0.07	0.07	0.09	0.10
		185 - 275	65-96	640-940	30	0.06	0.06	0.08	0.09

7xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
61 M/min • 0.80	= 48.8 M/min
0.20 mm/rev • 0.80	= 0.16 mm/rev

10xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (10xD)
61 M/min • 0.70	= 42.7 M/min
0.20 mm/rev • 0.70	= 0.14 mm/rev

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

Feed Rate (mm/rev) by Diameter									
15 series 15.00 - 15.99	16 series 16.00 - 16.99	17 series 17.00 - 17.99	18 series 18.00 - 19.99	20 series 20.00 - 21.99	22 series 22.00 - 23.99	24 series 24.00 - 25.99	26 series 26.00 - 28.99	29 series 29.00 - 31.99	32 series 32.00 - 35.00
0.38	0.41	0.43	0.48	0.53	0.56	0.58	0.61	0.64	0.66
0.36	0.38	0.41	0.43	0.48	0.51	0.53	0.56	0.58	0.61
0.30	0.33	0.36	0.41	0.46	0.48	0.51	0.53	0.56	0.58
0.38	0.41	0.43	0.48	0.53	0.56	0.58	0.61	0.64	0.66
0.36	0.38	0.41	0.46	0.48	0.51	0.53	0.56	0.58	0.61
0.33	0.36	0.38	0.42	0.46	0.48	0.51	0.53	0.56	0.58
0.28	0.30	0.33	0.38	0.41	0.42	0.46	0.48	0.51	0.53
0.36	0.38	0.41	0.46	0.51	0.53	0.56	0.58	0.61	0.64
0.33	0.36	0.38	0.43	0.48	0.51	0.53	0.56	0.58	0.61
0.30	0.33	0.36	0.41	0.46	0.48	0.51	0.53	0.56	0.58
0.28	0.30	0.33	0.38	0.41	0.43	0.46	0.48	0.51	0.53
0.36	0.38	0.41	0.46	0.51	0.53	0.56	0.58	0.61	0.64
0.33	0.36	0.38	0.43	0.48	0.51	0.53	0.56	0.58	0.61
0.30	0.33	0.36	0.41	0.46	0.48	0.51	0.53	0.56	0.58
0.25	0.28	0.30	0.36	0.38	0.41	0.43	0.46	0.48	0.51
0.23	0.25	0.28	0.33	0.36	0.38	0.41	0.43	0.46	0.48
0.28	0.30	0.33	0.36	0.38	0.41	0.43	0.46	0.48	0.51
0.25	0.28	0.28	0.30	0.33	0.36	0.38	0.41	0.43	0.46
0.23	0.25	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.43
0.33	0.38	0.38	0.43	0.48	0.53	0.56	0.58	0.61	0.64
0.30	0.33	0.36	0.38	0.43	0.48	0.51	0.53	0.56	0.58
0.28	0.30	0.33	0.36	0.38	0.43	0.48	0.51	0.53	0.56
0.20	0.23	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41
0.18	0.20	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38
0.20	0.23	0.23	0.25	0.28	0.28	0.30	0.30	0.33	0.36
0.18	0.20	0.20	0.23	0.25	0.25	0.28	0.28	0.30	0.33
0.20	0.23	0.23	0.25	0.28	0.28	0.30	0.30	0.33	0.33
0.18	0.20	0.20	0.23	0.25	0.25	0.28	0.28	0.30	0.30
0.15	0.16	0.18	0.18	0.20	0.22	0.24	0.26	0.28	0.31
0.14	0.15	0.16	0.16	0.18	0.20	0.22	0.24	0.26	0.29
0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.43
0.18	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41
0.15	0.18	0.18	0.20	0.20	0.23	0.23	0.25	0.25	0.28
0.13	0.15	0.15	0.18	0.18	0.20	0.20	0.23	0.23	0.25
0.11	0.12	0.13	0.15	0.16	0.18	0.20	0.20	0.22	0.25
0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.18	0.20	0.22

Coolant Recommendations

	Stub, 3xD, 5xD		7xD		10xD	
Series	Pressure BAR	Flow Rate LPM	Pressure BAR	Flow Rate LPM	Pressure BAR	Flow Rate LPM
11	31	19	41	30	55	38
12	31	19	41	30	55	38
13	28	23	34	36	52	45
14	28	26	34	36	52	45
15	26	26	33	42	48	53
16	26	30	33	45	48	57
17	24	30	31	47	45	62
18	24	34	31	47	45	62
20	21	38	28	49	41	68
22	21	42	28	53	41	68
24	21	42	28	53	41	68
26	21	45	28	61	41	76
29	21	45	28	61	41	76
32	21	45	28	61	41	76

Recommended Drilling Data | Metric (mm)

ISO	Material	Hardness BHN`	Hardness kg	Hardness N/mm²	Speed (M/min)	Feed Rate (mm/rev) by Diameter 11 series 11.00 - 11.99	12 series 12.00 - 12.99	13 series 13.00 - 13.99	14 series 14.00 - 14.99
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	50	0.13	0.13	0.15	0.17
		500	160	1600	40	0.11	0.11	0.13	0.15
		600	210	2000	27	0.10	0.10	0.11	0.13
	Hardened Steel	300 - 400	104-139	1020-1365	51	0.13	0.13	0.15	0.17
		400 - 500	139+	1365+	40	0.11	0.11	0.13	0.15
K	**SG / Nodular Cast Iron**	120 - 150	44-50	430-500	168	0.27	0.30	0.33	0.36
		150 - 200	50-70	500-700	159	0.25	0.28	0.30	0.33
		200 - 220	70-77	700-755	141	0.22	0.25	0.28	0.30
		220 - 260	77-90	755-890	124	0.20	0.23	0.25	0.28
		260 - 320	90-104	890-1020	112	0.20	0.21	0.23	0.25
	Grey / White Iron	120 - 150	44-50	430-500	175	0.30	0.33	0.36	0.38
		150 - 200	50-70	500-700	168	0.28	0.30	0.33	0.36
		200 - 220	70-77	700-755	151	0.25	0.28	0.30	0.33
		220 - 260	77-90	755-890	130	0.23	0.25	0.28	0.30
		260 - 320	90-104	890-1020	116	0.23	0.25	0.28	0.30
N	**Cast Aluminium**	30	10	100	351	0.30	0.33	0.36	0.38
		180	62	600	262	0.28	0.30	0.33	0.36
	Wrought Aluminium	30	10	100	488	0.33	0.38	0.41	0.43
		180	62	600	351	0.30	0.36	0.38	0.41
	Aluminium Bronze	100 - 200	38-68	370-670	126	0.26	0.28	0.30	0.32
		200 - 250	68-87	670-855	103	0.22	0.24	0.26	0.28
	Brass	100	38	370	230	0.29	0.30	0.33	0.36
	Copper	60	21	200	149	0.07	0.08	0.09	0.11

7xD Adjustment Example (0.80 Adjustment)

Data • Adjustment Value	Speed/Feed (7xD)
61 M/min • 0.80	= 48.8 M/min
0.20 mm/rev • 0.80	= 0.16 mm/rev

10xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (10xD)
61 M/min • 0.70	= 42.7 M/min
0.20 mm/rev • 0.70	= 0.14 mm/rev

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Feed Rate (mm/rev) by Diameter									
15 series 15.00 - 15.99	16 series 16.00 - 16.99	17 series 17.00 - 17.99	18 series 18.00 - 19.99	20 series 20.00 - 21.99	22 series 22.00 - 23.99	24 series 24.00 - 25.99	26 series 26.00 - 28.99	29 series 29.00 - 31.99	32 series 32.00 - 35.00
0.19	0.21	0.23	0.25	0.27	0.27	0.29	0.29	0.31	0.31
0.17	0.19	0.21	0.23	0.25	0.25	0.27	0.27	0.29	0.29
0.15	0.17	0.19	0.21	0.23	0.23	0.25	0.25	0.25	0.27
0.19	0.21	0.22	0.23	0.25	0.25	0.27	0.27	0.29	0.29
0.17	0.19	0.20	0.21	0.23	0.23	0.25	0.25	0.27	0.27
0.38	0.41	0.46	0.51	0.53	0.56	0.58	0.61	0.64	0.66
0.36	0.38	0.43	0.48	0.51	0.53	0.56	0.58	0.61	0.63
0.33	0.36	0.41	0.46	0.48	0.51	0.53	0.56	0.58	0.60
0.30	0.33	0.38	0.43	0.46	0.48	0.51	0.53	0.56	0.58
0.28	0.30	0.36	0.38	0.43	0.46	0.48	0.51	0.53	0.55
0.41	0.43	0.48	0.53	0.56	0.58	0.61	0.64	0.66	0.69
0.38	0.41	0.46	0.51	0.53	0.56	0.58	0.61	0.64	0.66
0.36	0.38	0.43	0.51	0.51	0.53	0.56	0.58	0.61	0.64
0.33	0.36	0.41	0.46	0.48	0.51	0.53	0.56	0.58	0.61
0.33	0.36	0.38	0.43	0.46	0.48	0.51	0.53	0.56	0.58
0.41	0.43	0.46	0.48	0.51	0.53	0.56	0.58	0.61	0.64
0.38	0.41	0.43	0.46	0.48	0.51	0.53	0.56	0.58	0.58
0.46	0.48	0.51	0.53	0.56	0.61	0.66	0.69	0.74	0.76
0.43	0.46	0.48	0.53	0.56	0.58	0.64	0.66	0.71	0.74
0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.48	0.50
0.30	0.32	0.34	0.36	0.38	0.42	0.46	0.46	0.46	0.48
0.38	0.41	0.43	0.48	0.53	0.56	0.60	0.63	0.66	0.66
0.13	0.15	0.16	0.18	0.20	0.20	0.22	0.25	0.25	0.28

Coolant Recommendations

	Stub, 3xD, 5xD		7xD		10xD	
Series	Pressure BAR	Flow Rate LPM	Pressure BAR	Flow Rate LPM	Pressure BAR	Flow Rate LPM
11	31	19	41	30	55	38
12	31	19	41	30	55	38
13	28	23	34	36	52	45
14	28	26	34	36	52	45
15	26	26	33	42	48	53
16	26	30	33	45	48	57
17	24	30	31	47	45	62
18	24	34	31	47	45	62
20	21	38	28	49	41	68
22	21	42	28	53	41	68
24	21	42	28	53	41	68
26	21	45	28	61	41	76
29	21	45	28	61	41	76
32	21	45	28	61	41	76

Recommended Drilling Data | Imperial (inch)

ISO	Material	Hardness BHN	Hardness kg	Hardness N/mm²	Speed (SFM)	Feed Rate (IPR) by Diameter 11 series 0.4331 - 0.4723	12 series 0.4724 - 0.5117	13 series 0.5118 - 0.5511	14 series 0.5512 - 0.5905
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 150	38-50	370-500	550	0.011	0.012	0.013	0.014
		150 - 200	50-70	500-700	475	0.010	0.011	0.012	0.013
		200 - 250	70-88	700-870	425	0.008	0.009	0.010	0.011
	Low Carbon Stee l 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	30-46	300-450	520	0.011	0.012	0.013	0.014
		125 - 175	46-62	450-600	450	0.010	0.011	0.012	0.013
		175 - 225	62-77	600-775	410	0.009	0.010	0.011	0.012
		225 - 275	77-96	775-940	350	0.007	0.008	0.009	0.010
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	46-62	450-600	450	0.010	0.011	0.012	0.013
		175 - 225	62-77	600-775	410	0.009	0.010	0.011	0.012
		225 - 275	77-96	775-940	350	0.008	0.009	0.010	0.011
		275 - 325	96-111	940-1090	300	0.007	0.008	0.009	0.010
	Alloy Steel 4140, 5140, 8640, etc.	125 - 175	46-62	450-600	415	0.010	0.011	0.012	0.013
		175 - 225	62-77	600-775	380	0.009	0.010	0.011	0.012
		225 - 275	77-96	775-940	340	0.008	0.009	0.010	0.011
		275 - 325	96-111	940-1090	310	0.006	0.007	0.008	0.009
		325 - 375	111-129	1090-1265	280	0.006	0.006	0.007	0.008
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	77-104	600-1020	250	0.008	0.009	0.010	0.011
		300 - 350	104-121	1020-1180	225	0.006	0.007	0.008	0.009
		350 - 400	121-139	1180-1365	200	0.005	0.006	0.007	0.008
	Structural Steel A36, A285, A516, etc.	100 - 150	38-50	370-500	410	0.010	0.011	0.012	0.013
		150 - 250	50-88	500-850	330	0.008	0.009	0.010	0.011
		250 - 350	88-121	850-1180	305	0.007	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	265	0.006	0.007	0.007	0.008
		200 - 250	70-88	700-870	205	0.005	0.006	0.006	0.007
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 220	49-77	480-755	130	0.006	0.007	0.007	0.008
		220 - 310	77-101	755-990	100	0.005	0.006	0.006	0.007
	Titanium Alloy	140 - 220	49-77	480-755	140	0.005	0.006	0.007	0.008
		220 - 310	77-101	755-990	110	0.004	0.005	0.006	0.007
	Aerospace Alloy S82	185 - 275	65-96	640-940	165	0.004	0.004	0.005	0.005
		275 - 350	96-121	940-1180	135	0.003	0.003	0.004	0.005
M	**Stainless Steel 400 Series** 416, 420, etc.	185 - 275	65-96	640-940	240	0.006	0.007	0.007	0.008
		275 - 350	96-121	940-1180	180	0.005	0.006	0.006	0.007
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 185	49-65	480-640	220	0.004	0.005	0.005	0.006
		185 - 275	65-96	640-940	160	0.003	0.004	0.004	0.005
	Super Duplex Stainless Steel	135 - 185	49-65	480-640	125	0.003	0.003	0.003	0.004
		185 - 275	65-96	640-940	100	0.002	0.002	0.003	0.003

7xD Adjustment Example (0.80 Adjustment)

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

10xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (10xD)
200 SFM • 0.70	= 140 SFM
0.008 IPR • 0.70	= 0.0056 IPR

⚠ WARNING **Tool failure can cause serious injury. To prevent:**
- When using holders without support bushing, use a short GEN3SYS® holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holders more than 50 RPM unless it is engaged with the workpiece or fixture.

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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. For 7xD and 10xD holder lengths, see adjustment example above.

Feed Rate (IPR) by Diameter									
15 series 0.5906 - 0.6298	16 series 0.6299 - 0.6692	17 series 0.6693 - 0.7086	18 series 0.7087 - 0.7873	20 series 0.7874 - 0.8660	22 series 0.8661 - 0.9448	24 series 0.9449 - 1.0235	26 series 1.0236 - 1.1416	29 series 1.1417 - 1.2597	32 series 1.2598 - 1.3780
0.015	0.016	0.017	0.019	0.021	0.022	0.023	0.024	0.025	0.026
0.014	0.015	0.016	0.017	0.019	0.020	0.021	0.022	0.023	0.024
0.012	0.013	0.014	0.016	0.018	0.019	0.020	0.021	0.022	0.023
0.015	0.016	0.017	0.019	0.021	0.022	0.023	0.024	0.025	0.026
0.014	0.015	0.016	0.018	0.019	0.020	0.021	0.022	0.023	0.024
0.013	0.014	0.015	0.017	0.018	0.019	0.020	0.021	0.022	0.023
0.011	0.012	0.013	0.015	0.016	0.017	0.018	0.019	0.020	0.021
0.014	0.015	0.016	0.018	0.020	0.021	0.022	0.023	0.024	0.025
0.013	0.014	0.015	0.017	0.019	0.020	0.021	0.022	0.023	0.024
0.012	0.013	0.014	0.016	0.018	0.019	0.020	0.021	0.022	0.023
0.011	0.012	0.013	0.015	0.016	0.017	0.018	0.019	0.020	0.021
0.014	0.015	0.016	0.018	0.020	0.021	0.022	0.023	0.024	0.025
0.013	0.014	0.015	0.017	0.019	0.020	0.021	0.022	0.023	0.024
0.012	0.013	0.014	0.016	0.018	0.019	0.020	0.021	0.022	0.023
0.010	0.011	0.012	0.014	0.015	0.016	0.017	0.018	0.019	0.020
0.009	0.010	0.011	0.013	0.014	0.015	0.016	0.017	0.018	0.019
0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020
0.010	0.011	0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018
0.009	0.010	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017
0.013	0.015	0.015	0.017	0.019	0.021	0.022	0.023	0.024	0.025
0.012	0.013	0.014	0.015	0.017	0.019	0.020	0.021	0.022	0.023
0.011	0.012	0.013	0.014	0.015	0.017	0.019	0.020	0.021	0.022
0.008	0.009	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016
0.007	0.008	0.008	0.009	0.010	0.011	0.012	0.013	0.014	0.015
0.008	0.009	0.009	0.010	0.011	0.011	0.012	0.012	0.013	0.014
0.007	0.008	0.008	0.009	0.010	0.010	0.011	0.011	0.012	0.013
0.008	0.009	0.009	0.010	0.011	0.011	0.012	0.012	0.013	0.014
0.007	0.008	0.008	0.009	0.010	0.010	0.011	0.011	0.012	0.012
0.006	0.006	0.007	0.007	0.008	0.008	0.009	0.010	0.011	0.012
0.005	0.006	0.006	0.006	0.007	0.008	0.008	0.009	0.010	0.011
0.008	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017
0.007	0.008	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016
0.006	0.007	0.007	0.008	0.008	0.009	0.009	0.010	0.010	0.011
0.005	0.006	0.006	0.007	0.007	0.008	0.008	0.009	0.009	0.010
0.004	0.005	0.005	0.006	0.006	0.007	0.008	0.008	0.008	0.010
0.004	0.004	0.005	0.005	0.006	0.006	0.007	0.007	0.008	0.008

Coolant Recommendations

	Stub, 3xD, 5xD		7xD		10xD	
Series	Pressure PSI	Flow Rate GPM	Pressure PSI	Flow Rate GPM	Pressure PSI	Flow Rate GPM
11	450	5	600	8	800	10
12	450	5	600	8	800	10
13	400	6	500	9.5	750	12
14	400	7	500	9.5	750	12
15	380	7	475	11	700	14
16	380	8	475	12	700	15
17	350	8	450	12.5	650	16.5
18	350	9	450	12.5	650	16.5
20	300	10	400	13	600	18
22	300	11	400	14	600	18
24	300	11	400	14	600	18
26	300	12	400	16	600	20
29	300	12	400	16	600	20
32	300	12	400	16	600	20

Recommended Drilling Data | Imperial (inch)

ISO	Material	Hardness BHN	Hardness kg	Hardness N/mm²	Speed (SFM)	Feed Rate (IPR) by Diameter: 11 series 0.4331 - 0.4723	12 series 0.4724 - 0.5117	13 series 0.5118 - 0.5511	14 series 0.5512 - 0.5905
H	**Wear Plate** Hardox, AR400, T-1, etc.	400	139	1365	160	0.005	0.005	0.006	0.006
		500	160	1600	130	0.004	0.004	0.005	0.006
		600	210	2000	90	0.004	0.004	0.004	0.005
	Hardened Steel	300 - 400	104-139	1020-1365	170	0.005	0.005	0.006	0.006
		400 - 500	139+	1365+	130	0.004	0.004	0.005	0.006
K	**SG / Nodular Cast Iron**	120 - 150	44-50	430-500	550	0.010	0.012	0.013	0.014
		150 - 200	50-70	500-700	520	0.010	0.011	0.012	0.013
		200 - 220	70-77	700-755	465	0.008	0.010	0.011	0.012
		220 - 260	77-90	755-890	405	0.008	0.009	0.010	0.011
		260 - 320	90-104	890-1020	365	0.008	0.008	0.009	0.010
	Grey / White Iron	120 - 150	44-50	430-500	575	0.012	0.013	0.014	0.015
		150 - 200	50-70	500-700	550	0.011	0.012	0.013	0.014
		200 - 220	70-77	700-755	495	0.010	0.011	0.012	0.013
		220 - 260	77-90	755-890	425	0.009	0.010	0.011	0.012
		260 - 320	90-104	890-1020	380	0.009	0.010	0.011	0.012
N	**Cast Aluminium**	30	10	100	1150	0.012	0.013	0.014	0.015
		180	62	600	860	0.011	0.012	0.013	0.014
	Wrought Aluminium	30	10	100	1600	0.013	0.015	0.016	0.017
		180	62	600	1150	0.012	0.014	0.015	0.016
	Aluminium Bronze	100 - 200	38-68	370-670	415	0.010	0.011	0.012	0.012
		200 - 250	68-87	670-855	335	0.008	0.009	0.010	0.011
	Brass	100	38	370	755	0.010	0.012	0.013	0.014
	Copper	60	21	200	490	0.003	0.003	0.003	0.004

7xD Adjustment Example (0.80 Adjustment)

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

10xD Adjustment Example (0.70 Adjustment)

Speed • Adjustment Value	Speed/Feed (10xD)
200 SFM • 0.70	= 140 SFM
0.008 IPR • 0.70	= 0.0056 IPR

WARNING **Tool failure can cause serious injury. To prevent:**
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Feed Rate (IPR) by Diameter									
15 series 0.5906 - 0.6298	**16 series 0.6299 - 0.6692**	**17 series 0.6693 - 0.7086**	**18 series 0.7087 - 0.7873**	**20 series 0.7874 - 0.8660**	**22 series 0.8661 - 0.9448**	**24 series 0.9449 - 1.0235**	**26 series 1.0236 - 1.1416**	**29 series 1.1417 - 1.2597**	**32 series 1.2598 - 1.3780**
0.007	0.008	0.009	0.010	0.010	0.010	0.011	0.011	0.012	0.012
0.006	0.007	0.008	0.009	0.010	0.010	0.010	0.010	0.011	0.011
0.006	0.006	0.007	0.008	0.009	0.009	0.010	0.010	0.010	0.010
0.007	0.008	0.008	0.009	0.010	0.010	0.010	0.010	0.011	0.011
0.006	0.007	0.008	0.008	0.009	0.009	0.010	0.010	0.010	0.010
0.015	0.016	0.018	0.020	0.020	0.022	0.022	0.024	0.025	0.026
0.014	0.015	0.017	0.019	0.020	0.020	0.022	0.022	0.024	0.024
0.013	0.014	0.016	0.018	0.019	0.020	0.020	0.022	0.022	0.023
0.012	0.013	0.015	0.017	0.018	0.019	0.020	0.020	0.022	0.022
0.011	0.012	0.014	0.015	0.017	0.018	0.019	0.020	0.020	0.021
0.016	0.017	0.019	0.021	0.022	0.023	0.024	0.025	0.026	0.027
0.015	0.016	0.018	0.020	0.021	0.022	0.023	0.024	0.025	0.026
0.014	0.015	0.017	0.020	0.020	0.021	0.022	0.023	0.024	0.025
0.013	0.014	0.016	0.018	0.019	0.020	0.021	0.022	0.023	0.024
0.013	0.014	0.015	0.017	0.018	0.019	0.020	0.021	0.022	0.023
0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025
0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.023
0.018	0.019	0.020	0.022	0.023	0.024	0.026	0.027	0.029	0.030
0.017	0.018	0.019	0.021	0.022	0.023	0.025	0.026	0.028	0.029
0.013	0.014	0.015	0.015	0.016	0.017	0.018	0.019	0.019	0.019
0.012	0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.018	0.019
0.015	0.016	0.017	0.019	0.020	0.022	0.023	0.024	0.026	0.026
0.005	0.006	0.006	0.007	0.008	0.008	0.008	0.010	0.010	0.011

Coolant Recommendations

	Stub, 3xD, 5xD		7xD		10xD	
Series	**Pressure PSI**	**Flow Rate GPM**	**Pressure PSI**	**Flow Rate GPM**	**Pressure PSI**	**Flow Rate GPM**
11	450	5	600	8	800	10
12	450	5	600	8	800	10
13	400	6	500	9.5	750	12
14	400	7	500	9.5	750	12
15	380	7	475	11	700	14
16	380	8	475	12	700	15
17	350	8	450	12.5	650	16.5
18	350	9	450	12.5	650	16.5
20	300	10	400	13	600	18
22	300	11	400	14	600	18
24	300	11	400	14	600	18
26	300	12	400	16	600	20
29	300	12	400	16	600	20
32	300	12	400	16	600	20

Tap Drill Information and Formulas | Metric (mm)

Tap Size	Tap Drill Size	Decimal Equivalent (inch)	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
12 X 1.25	27/64	.4219	79%	0.075 mm	10.79 mm	74%
	10.8 mm	.4252	74%	0.075 mm	10.88 mm	69%
14 X 2.0	15/32	.4688	81%	0.075 mm	11.98 mm	78%
	12.0 mm	.4724	77%	0.075 mm	12.08 mm	74%
14 X 1.5	12.5 mm	.4921	77%	0.075 mm	12.58 mm	73%
16 X 2.0	14.0 mm	.5512	77%	0.075 mm	14.08 mm	74%
16 X 1.5	14.5 mm	.5709	77%	0.075 mm	14.58 mm	73%
	37/64	.5781	68%	0.075 mm	14.76 mm	64%
18 X 2.5	15.5 mm	.6102	77%	0.075 mm	15.58 mm	75%
18 X 1.5	16.5 mm	.6496	77%	0.075 mm	16.58 mm	73%
	21/32	.6563	68%	0.075 mm	16.75 mm	64%
20 X 2.5	11/16	.6875	78%	0.075 mm	17.54 mm	76%
	17.5 mm	.6890	77%	0.075 mm	17.58 mm	74%
20 X 1.5	18.5 mm	.7283	77%	0.075 mm	18.58 mm	73%
	47/64	.7344	69%	0.075 mm	18.66 mm	65%
22 X 2.5	49/64	.7656	79%	0.075 mm	19.52 mm	76%
	19.5 mm	.7677	77%	0.075 mm	19.58 mm	75%
22 X 1.5	20.5 mm	.8071	77%	0.075 mm	20.58 mm	73%
	13/16	.8125	70%	0.075 mm	20.71 mm	66%
24 X 3	13/16	.8125	86%	0.075 mm	20.71 mm	84%
	21.0 mm	.8268	76%	0.075 mm	21.08 mm	75%
24 X 2	22.0 mm	.8661	77%	0.075 mm	22.08 mm	74%
	7/8	.8750	68%	0.075 mm	22.30 mm	65%
27 X 3	24.0 mm	.9449	77%	0.075 mm	24.08 mm	75%

Formulas

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

BSP and ISO 7-1

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
1/4-19	7/16"	.4375"	–	0.075 mm	11.19 mm	–
3/8-19	37/64"	.5781"	–	0.075 mm	14.76 mm	–
1/2-14	23/32"	.7188"	–	0.075 mm	18.33 mm	–
3/4-14	15/16"	.9375"	–	0.075 mm	23.89 mm	–

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

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

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

Material Constants

Type of Material	Hardness	Km (kPa)
Plain Carbon and Alloy Steel	85 - 200 BHN	5.45
	200 - 275 BHN	6.48
	275 - 375 BHN	6.89
	375 - 425 BHN	7.93
High Temperature Alloys	–	9.93
Titanium Alloy	–	4.96
Stainless Steels	135 - 275 BHN	6.48
	30 - 45 RC	7.45
Cast Iron	100 - 200 BHN	3.45
	200 - 300 BHN	7.45
Copper Alloy	20 - 80 RB	2.96
	80 - 100 RB	4.96
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 requirement.
- The .075mm probable mean oversize hole condition is based on optimum cutting conditions. Probable percent of full thread may vary based on less ideal cutting conditions.
- The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the Editor of the *Machinery's Handbook*.

Tap Drill Information and Formulas | Imperial (inch)

American - Unified Inch Screw Thread

Tap Size	Tap Drill Size	Decimal Equivalent	* Theo % Thread	Probable Mean Oversize	Probable Hole Size	** Probable % Thread
1/2 - 20	29/64	.4531	72%	.003	.4561	68%
9/16 - 12	12.0 mm	.4724	72%	.003	.4754	69%
	31/64	.4844	83%	.003	.4874	80%
9/16 - 18	1/2	.5000	87%	.003	.5030	82%
	13.0 mm	.5118	70%	.003	.5148	66%
	31/64	.5156	65%	.003	.5186	61%
5/8 - 11	17/32	.5313	79%	.003	.5343	77%
5/8 - 12	35/64	.5469	72%	.003	.5499	69%
5/8 - 18	9/16	.5625	87%	.003	.5655	82%
	14.5 mm	.5709	75%	.003	.5739	71%
	37/64	.5781	65%	.003	.5811	61%
11/16 - 12	39/64	.6094	72%	.003	.6124	69%
3/4 - 10	41/64	.6406	84%	.003	.6436	82%
	16.5 mm	.6496	77%	.003	.6526	75%
	21/32	.6563	72%	.003	.6593	70%
3/4 - 12	43/64	.6719	72%	.003	.6749	69%
3/4 - 16	11/16	.6875	77%	.003	.6905	73%
	17.5 mm	.6890	75%	.003	.6920	71%
7/8 - 9	49/64	.7656	76%	.003	.7686	74%
	25/32	.7813	65%	.003	.7843	63%
7/8 - 14	51/64	.7969	84%	.003	.7999	81%
	13/16	.8125	67%	.003	.8155	64%
15/16 - 12	55/64	.8594	72%	.003	.8624	69%
15/16 - 20	57/64	.8906	72%	.003	.8936	68%
1 - 8	22.0 mm	.8661	82%	.003	.8691	81%
	7/8	.8750	77%	.003	.8780	75%
	57/64	.8906	67%	.003	.8936	65%
1 - 12	29/32	.9063	87%	.003	.9093	84%
	59/64	.9219	72%	.003	.9249	69%
1 - 14	15/16	.9375	67%	.003	.9405	64%
1-1/8 - 12	1-1/32	1.0313	87%	.003	1.0343	84%
	1-3/64	1.0469	72%	.003	1.0499	69%
1-1/4 - 7	1-7/64	1.1094	76%	.003	1.1124	74%

Formulas

1. **RPM = (3.82 • SFM) / DIA**

where:

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

2. **IPM = RPM • IPR**

where:

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

3. **SFM = RPM • 0.262 • DIA**

where:

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

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

where:

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

5. **Tool Power = .6283 • IPR • RPM • Km • DIA^2**

where:

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

Taper Pipe Thread (NPT)

Tap Size	Tap Drill Size		Decimal Equiva-lent	* Theo % Thread	Probable Mean Oversize	Prob-able Hole Size	** Probable % Thread
	Metric (mm)	Imperial					
1/4 - 18	11.10	7/16	.4375	–	.003	.4405	–
3/8 - 18	14.70	9/16	.5625	–	.003	.5655	–
1/2 - 14	18.25	45/64	.7031	–	.003	.7061	–
3/4 - 14	23.80	29/32	.9063	–	.003	.9093	–

* Based on nominal tap drill diameter

** Based on .003" probable mean oversize

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

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

Material Constants

Type of Material	Hardness	Km (lbs/in^2)
Plain Carbon and Alloy Steel	85 - 200 BHN	0.79
	200 - 275 BHN	0.94
	275 - 375 BHN	1.00
	375 - 425 BHN	1.15
High Temperature Alloys	–	1.44
Titanium Alloy	–	0.72
Stainless Steels	135 - 275 BHN	0.94
	30 - 45 RC	1.08
Cast Iron	100 - 200 BHN	0.50
	200 - 300 BHN	1.08
Copper Alloy	20 - 80 RB	0.43
	80 - 100 RB	0.72
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 requirement.
- The .003 probable mean oversize hole condition is based on optimum cutting conditions. Probable percent of full thread may vary based on less ideal cutting conditions.
- The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the Editor of the *Machinery's Handbook*.

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	Oversize hole	Poor hole finish	Poor tool life	Power spikes - Load meter	Retract spiral	
Setup Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**Possible Solutions**
Worn or misaligned spindle (lathe, screw machine, chucker)	1		3				7		9	10	11		13			16	17			20	• Align spindle and turret or tailstock. • Repair spindle.
Use of low rigidity machine tools		2	3	4			7		9	10			13	14						20	• Reduce penetration rate to fall within the physical limits of the machine or setup (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Poor work piece support		2		4			7			10	11				15		17			20	• Provide additional support for the work piece. • Reduce penetration rate to fall within the physical limits of the machine or setup (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Flood coolant, low coolant pressure, or low coolant volume	1				5	6		8		10		12				16	17	18	19		• Run coolant through tool holder when drilling greater than 1xD. • Increase coolant pressure and volume through the tool holder. • Reduce penetration rate to fall within the coolant limitations (**NOTICE:** Do not reduce feed below threshold of good chip formation). • Add a peck cycle to help clear chips.
Interrupted cuts. Entry or exit surfaces that are not perpendicular to the spindle (draft angles, parting lines, curved or stepped surfaces, cross holes, and cast or forged surfaces)				4			7		9	10	11		13	14	15	16	17	18			• Pre-mill (spot face) entry or exit surface to remove interruption. • Decrease feed as much as 50% through entry or exit interruption. • Use short holders in low impact entry cuts.
Material harder than expected or running tools beyond recommended speed	1				5	6				10		12						18			• Reduce speed. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance.
Poor material micro-structure or foreign particles (forgings and castings that have not been normalized or annealed, poorly prepared steel, flame cut parts, and sand casting)				4		6				10		12	13					18			• Compare performance of other tools for similar wear problems, which may indicate poor micro-structure. Anneal or normalize parts to improve micro-structure for machining. • Reduce feeds (**NOTICE:** Do not reduce feed below threshold of good chip formation).
Poor chip control								8		10	11		13			16	17	18	19		• Increase feed to recommended levels. Contact Allied Application Engineering group for technical recommendations. • Increase coolant pressure and volume. • Improve coolant condition by use of quality products and regular maintenance.
Spot drilled holes with included angle less than that matching GEN3SYS®XT or cored holes	1			4			7						13					18			• Spot hole with short tool of same or greater included angle as GEN3SYS®XT drill insert. • Reduce feed (**NOTICE:** Do not reduce feed below threshold of good chip formation). If possible, drill from solid.