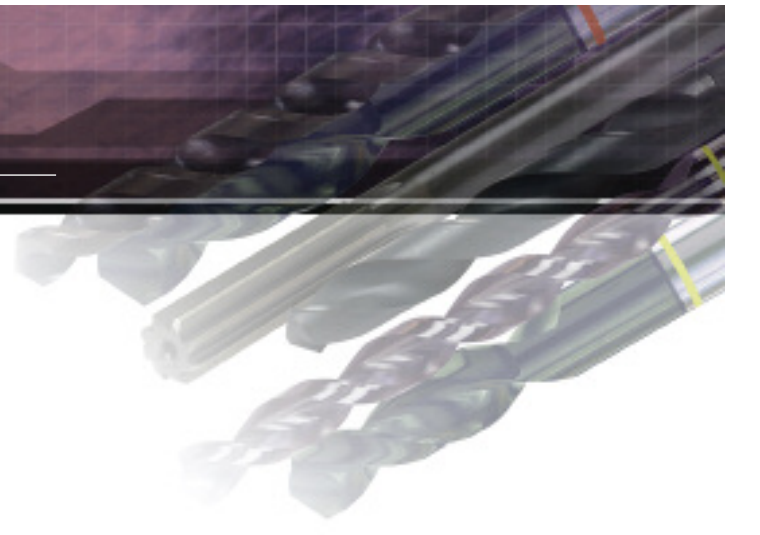
When To Use M-4:
- Loose machines
- Manual machines
- Cross hole drilling

When To Use T15:
- On CNC machines
- When M-4 life need to be extended
- Abrasive drilling

RECOMMENDED BLADE SELECTION AND SPEEDS & FEEDS

Material	Material Rockwell Hardness (HRC)	Rec. Blade HSS-M4 ⊖HSCO-T15	TIN SFM Surface Footage	TIALN SFM Surface Footage	Feed (IPR) 3/8" to 1/2"	33/64" to 11/16"	45/64" to 15/16"	31/32" to 1-3/8"	1-13/32" to 1-7/8"	1-29/32" to 2-9/16"	2-19/32" to 4-1/2"
Free Machining Steel	-			280	.007	.010	.013	.016	.020	.023	.028
1118, 1215,	< 12			260	.007	.010	.013	.016	.020	.023	.028
12L14, etc.	12-25			240	.007	.010	.013	.016	.020	.023	.028
Low & Medium	< 7		160	240	.006	.009	.012	.015	.019	.023	.027
Carbon Steel	7-20		150	225	.005	.0098	.010	.014	.018	.021	.024
1018, 1040,	20-29		140	210	.005	.0098	.010	.014	.018	.021	.024
12L14, etc.	29-35	⊖	130	195	.004	.007	.009	.012	.016	.019	.022
Alloy Steel	< 7		150	210	.006	.008	.010	.014	.017	.019	.022
4140,	7-20		140	195	.005	.008	.010	.014	.017	.019	.022
5140	20-29		130	180	.005	.007	.010	.014	.017	.019	.022
8640,	29-35	⊖	120	170	.004	.006	.009	.012	.015	.017	.020
etc.	35-40	⊖	110	155	.003	.006	.009	.012	.015	.017	.020
High Strength Alloy Steel	20-32	⊖	80	110	.005	.007	.009	.010	.014	.017	.020
4340, 4330V,	32-37	⊖	60	85	.004	.007	.009	.010	.014	.017	.020
300M, etc.	37-43		50	70	.003	.006	.008	.009	.012	.015	.018
Structural Steel	-		140	200	.006	.010	.012	.014	.018	.021	.026
A36, A285	12-25		120	170	.005	.009	.010	.012	.016	.019	.024
A516, etc.	37-43	⊖	100	140	.004	.008	.009	.010	.014	.017	.020
High Temp, Alloy	< 18	⊖	30	40	.003	.006	.007	.008	.010	.012	.015
Hastelloy B, Inconel 600, etc.	18-32	⊖	25	35	.003	.006	.007	.008	.010	.012	.015
Stainless Steel	< 7		75	105	.006	.008	.009	.011	.014	.016	.020
303, 416, 420, 17-4 PH, etc.	7-29		60	90	.005	.007	.008	.010	.012	.014	.018
Tool Steel	< 12	⊖	80	110	.004	.006	.008	.010	.012	.015	.017
H-13, H021, AD4, O-2, S-3, etc	12-25	⊖	60	90	.004	.006	.008	.010	.012	.015	.017
Aluminum	< 6		600	850	.008	.013	.016	.020	.022	.025	.025
			300	450	.008	.013	.016	.018	.022	.025	.025
Cast Iron	-		170	250	.007	.012	.016	.020	.024	.027	.030
Gray,	<12		150	225	.006	.011	.014	.018	.022	.025	.028
Ductile,	12-18		130	195	.006	.009	.012	.016	.018	.021	.024
Nodular	18-26	⊖	110	165	.005	.007	.009	.012	.014	.017	.020
	26-32	⊖	90	135	.004	.006	.007	.009	.012	.014	.016

Note: The speeds and feeds listed above are considered a general starting point for all applications.
Factors such as material, material hardness, coolant pressure, hole diameter and length to diameter ratio should also be considered when making these recommendations.
Speed and feed reductions are recommended when using extended length holders.



THROW-AWAY DRILL INSERTS – COOLANT PRESSURE

		High Speed Steel (TiN, TiAlN) Coolant Pressure (PSI) Coolant Volumetric Flowrate (GPM)						
Material	Material Hardness (BHN)	3/8" - 1/2"	33/64" - 11/16"	23/32" - 1"	1" - 1-1/4"	1/4" - 1"	2" - 3"	3" - 4"
Free Machining Steel		175 - 185	100 - 120	105 - 140	80 - 115	75 - 100	40 - 50	65 - 90
1118, 1215, 12L14, etc.	100 - 250	2.5 - 2.6	2.8 - 3.0	4.4 - 5.2	7 - 8	12 - 14	30 - 33	38 - 44
Low Carbon Steel		165 - 170	75 - 90	75 - 95	60 - 80	55 - 75	30 - 40	50 - 65
1010, 1020, 1025, 1522, etc.	85 - 275	2.4 - 2.5	2.4 - 2.6	3.7 - 4.2	6 - 7	11 - 12	26 - 30	33 - 38
Medium Carbon Steel		160 - 165	70 - 85	70 - 90	55 - 70	50 - 70	30 - 40	50 - 65
1030, 1040, 1050, 1527, 1140, 1151	125 - 325	2.3 - 2.4	2.3 - 2.6	3.6 - 4.1	5 - 6	10 - 12	26 - 30	33 - 38
Alloy Steel		160 - 165	66 - 75	65 - 80	50 - 70	45 - 60	30 - 35	40 - 50
4140, 5140, 8640, etc.	125 - 375	2.3 - 2.5	2.2 - 2.4	3.5 - 3.9	5 - 6	10 - 11	26 - 28	30 - 33
High Strength Alloy		150 - 155	55 - 60	45 - 50	25 - 30	25 - 30	20 - 25	25 - 30
	225 - 400	2.3 - 2.4	2.1 - 2.2	2.90 - 3.1	4 - 5	7 - 8	21 - 23	23 - 26
Structural Steel		160 - 165	75 - 85	65 - 80	40 - 55	40 - 50	25 - 30	40 - 50
	100 - 350	2.3 - 2.4	2.4 - 2.6	3.5 - 3.9	5 - 6	9 - 10	23 - 26	33 - 33
High Temp. Alloy		150 - 155	60 - 65	50 - 55	30 - 35	25 - 30	25 - 30	-
Hastelloy B, Inconel 600, etc.	140 - 310	2.3 - 2.4	2.2 - 2.3	3.1 - 3.2	4 - 5	7 - 8	23 - 26	-
Stainless Steel		165 - 170	70 - 85	65 - 75	40 - 55	40 - 50	25 - 30	35 - 45
301, 316, 330, 17-4Ph, etc.	135 - 275	2.4 - 2.5	2.3 - 2.6	3.5 - 3.7	5 - 6	9 - 10	23 - 26	28 - 31
Tool Steel		150 - 155	55 - 60	45 - 50	25 - 30	25 - 30	20 - 25	25 - 30
H-13, H-21, A-4, O-2, S-3, etc	150 - 250	2.3 -2.4	2.1 -2.2	2.9 - 3.1	4 - 5	7 - 8	21 - 23	23 - 26
Aluminum		190 - 210	140 - 180	150 - 200	115 - 160	90 - 125	40 - 50	60 - 80
	30 - 180	2.6 - 2.7	3.3 - 3.7	5.3 - 6.1	8 - 9	14 - 16	30 - 33	36 - 42
Cast Iron		155 - 160	60 - 65	50 - 60	30 - 40	30 - 36	25 - 30	30 - 35
	120 - 320	2.3 - 2.4	2.2 - 2.3	3.1 - 3.3	4 - 4	8 - 9	23 - 26	26 - 28

THROW-AWAY DRILL INSERTS SPADE DRILL HORSEPOWER CONSUMPTION RATE

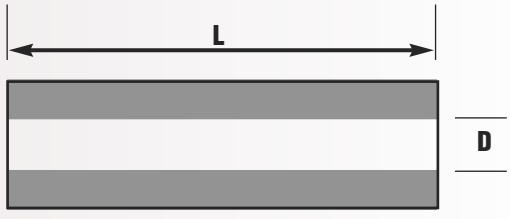
Metal Removal Rates (MRR)
Example: 1.50 dia. drill @6.412 I.P.M.

Volume of Cylinder Method: D2 x .785 x L
D=Hole Diameter
L=Length in I.P.M.
.785 is Constant

Material Drilled 4140 250 BHN:
Cutting Data: 180 S.F.M. (458 R.P.M.) x .014 Feed per Rev.

458 R.P.M. x .014 = 6.412 I.P.M. (L)
D2 (1.5)2 x .785 x L (6.412) = 5 C.U. In./Min (MRR)

MRR of 5 x 1.4 Energy Value = 7HP



METAL REMOVAL RATES (MRR)

- Cubic inches of metal removal per unit of horsepower
- Unit horsepower (HPu) is the amount of power to remove a volume of metal in a period of time
- HPu = power to cut 1 cubic inch per minute – found in tables

AVERAGE UNIT HORSEPOWER VALUES OF ENERGY PER UNIT VOLUME

Material	BHN	HPu [HP/(in3)min.)]
Carbon Steels	150 - 200	1.0
	200 - 250	1.4
	250 - 350	1.6
Leaded Steels	150 - 175	0.7
Cast Irons	125 - 190	0.5
	190 - 250	1.6
Stainless Steels	135 - 275	1.5
Aluminum Alloys	50 - 100	0.3
Magnesium Alloys	40 - 90	0.2
Copper	125 - 140	0.7
Copper Alloys	100 - 150	0.7