

Speeds and Feeds



- 1) Select your material in the ISO colored chart with respect to material description and hardness (HB). Use the recommended insert chip groove based on your selection.
- 2) Start with the recommended cutting speed, v_c (ft/min) and feed per revolution, f_r (in/rev) according to tool diameter. Adjust the cutting speed and/or feed rate based on your cutting conditions.

Material					Recommended Cutting Speed			Recommended Feed Per Revolution			
Group	Description	Hardness (HB)	Insert Chip Groove	Grade	Min	Starting Value	Max	Tool Diameter (in)			
								0.473 - 0.531" Ø (Size A)	0.563 - 0.734" Ø (Size B)	0.750 - 0.938" Ø (Size C)	0.969 - 1.156" Ø (Size D)
P	0 Low-Carbon Steels, Long Chipping	<125	HL	PM35	360	540	780	0.0024 - 0.0031	0.0031 - 0.0043	0.0039 - 0.0051	0.0043 - 0.0055
	1 Low-Carbon Steels, Short Chipping, Free Machining	<125	HL	PM35	360	540	780	0.0024 - 0.0039	0.0031 - 0.0051	0.0039 - 0.0059	0.0043 - 0.0063
	2 Medium- and High-Carbon Steels	<220	HP	PM35	360	570	840	0.0024 - 0.0039	0.0031 - 0.0059	0.0039 - 0.0063	0.0043 - 0.0067
	3 Alloy Steels and Tool Steels	<330	HP	PM35	360	600	930	0.0031 - 0.0059	0.0039 - 0.0063	0.0043 - 0.0071	0.0047 - 0.0079
	4 Alloy Steels and Tool Steels	340–450	HP	PM35	360	570	930	0.0031 - 0.0059	0.0039 - 0.0063	0.0043 - 0.0071	0.0047 - 0.0079
	5 Ferritic, Martensitic, and PH Stainless Steels	<330	HM	PM35	360	540	750	0.0024 - 0.0039	0.0031 - 0.0055	0.0039 - 0.0059	0.0043 - 0.0063
	6 High-Strength Ferritic, Martensitic, and PH Stainless Steels	350–450	HM	PM35	360	480	630	0.0024 - 0.0039	0.0031 - 0.0055	0.0039 - 0.0059	0.0043 - 0.0063
M	1 Austenitic Stainless Steel	130–200	HL	PM35	360	480	720	0.0024 - 0.0047	0.0028 - 0.0051	0.0031 - 0.0059	0.0039 - 0.0063
	2 High-Strength Austenitic Stainless and Cast Stainless Steel	150–230	HL	PM35	330	420	630	0.0024 - 0.0047	0.0028 - 0.0051	0.0031 - 0.0059	0.0039 - 0.0063
	3 Duplex Stainless Steel	135–275	HM	PM35	300	360	600	0.0024 - 0.0047	0.0028 - 0.0051	0.0031 - 0.0059	0.0039 - 0.0063
K	1 Gray Cast Iron	120–290	HP	PM35	360	600	840	0.0031 - 0.0055	0.0031 - 0.0063	0.0039 - 0.0071	0.0047 - 0.0094
	2 Low- and Medium-Strength Ductile Irons (Nodular) and Compacted Graphite Irons	130–260	HP	PM35	300	540	780	0.0031 - 0.0055	0.0031 - 0.0063	0.0039 - 0.0071	0.0047 - 0.0094
	3 High-Strength Ductile Irons and Austempered Ductile Iron	180–350	HP	PM35	300	510	720	0.0031 - 0.0055	0.0031 - 0.0063	0.0039 - 0.0071	0.0047 - 0.0094
N	1 Wrought Aluminum	-	HA	HN25	750	1050	1500	0.0024 - 0.0039	0.0031 - 0.0055	0.0039 - 0.0059	0.0043 - 0.0063
	2 Low-Silicon Aluminum Alloys and Magnesium Alloys	-	HA	HN25	450	900	1350	0.0024 - 0.0039	0.0031 - 0.0055	0.0039 - 0.0059	0.0043 - 0.0063
	3 High-Silicon Aluminum Alloys and Magnesium Alloys	-	HA	HN25	240	360	450	0.0024 - 0.0039	0.0028 - 0.0043	0.0031 - 0.0047	0.0039 - 0.0055
S	3 Nickel-Based, Heat-Resistant Alloys	160-450	HL	PM35	60	90	135	0.0031 - 0.0047	0.0031 - 0.0051	0.0039 - 0.0059	0.0047 - 0.0075
	4 Titanium and Titanium Alloys	300-400	HL	PM35	105	120	195	0.0031 - 0.0047	0.0031 - 0.0051	0.0039 - 0.0059	0.0047 - 0.0075

NOTE: All speed conditions are for stable conditions. For unstable conditions, it is suggested to reduce starting speeds by 10%. For interrupted cuts, reduce by 20%.
 For 4 X D, it is highly recommended to start with feed and speed values reduced by 10% less than above data.
 For 5 X D, diameter range 0.473 – 0.938" (insert sizes A to C), it is highly recommended to start with feed and speed values reduced by 20% less than above data.
 For 5 X D, diameter range 0.969 – 2.5" (inserts sizes D to H), it is highly recommended to start with feed and speed values reduced by 15% less than above data.
 For 4 X D and 5 X D, it is recommended to reduce feed rate during entry and exit by 30–50%.

WARNING: During through-hole operations, a slug or disc is produced as the tool breaks through the workpiece. When the drill is stationary and the workpiece is rotating, this slug may be hurled from the chuck by centrifugal force. Provide adequate shielding to protect bystanders.

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Material					Recommended Cutting Speed			Recommended Feed Per Revolution			
Group	Description	Hardness (HB)	Insert Chip Groove	Grade	Min	Starting Value	Max	Tool Diameter (in)			
								1.188 - 1.438" Ø (Size E)	1.469 - 1.750" Ø (Size F)	1.813 - 2.219" Ø (Size G)	2.250 - 2.500" Ø (Size H)
P	0 Low-Carbon Steels, Long Chipping	<125	HL	PM35	360	540	780	0.0051 - 0.0063	0.0059 - 0.0071	0.0063 - 0.0091	0.0067 - 0.0094
	1 Low-Carbon Steels, Short Chipping, Free Machining	<125	HL	PM35	360	540	780	0.0051 - 0.0071	0.0059 - 0.0079	0.0063 - 0.0106	0.0067 - 0.0114
	2 Medium- and High-Carbon Steels	<220	HP	PM35	360	570	840	0.0051 - 0.0079	0.0059 - 0.0083	0.0063 - 0.0110	0.0067 - 0.0118
	3 Alloy Steels and Tool Steels	<330	HP	PM35	360	600	930	0.0053 - 0.0094	0.0063 - 0.0094	0.0071 - 0.0118	0.0075 - 0.0126
	4 Alloy Steels and Tool Steels	340–450	HP	PM35	360	570	930	0.0055 - 0.0087	0.0063 - 0.0094	0.0071 - 0.0118	0.0075 - 0.0126
	5 Ferritic, Martensitic, and PH Stainless Steels	<330	HM	PM35	360	540	750	0.0051 - 0.0071	0.0059 - 0.0079	0.0063 - 0.0110	0.0067 - 0.0118
	6 High-Strength Ferritic, Martensitic, and PH Stainless Steels	350–450	HM	PM35	360	480	630	0.0051 - 0.0071	0.0059 - 0.0079	0.0063 - 0.0110	0.0067 - 0.0114
M	1 Austenitic Stainless Steel	130–200	HL	PM35	360	480	720	0.0047 - 0.0079	0.0055 - 0.0098	0.0063 - 0.0110	0.0063 - 0.0118
	2 High-Strength Austenitic Stainless and Cast Stainless Steel	150–230	HL	PM35	330	420	630	0.0047 - 0.0079	0.0055 - 0.0098	0.0063 - 0.0110	0.0063 - 0.0118
	3 Duplex Stainless Steel	135–275	HM	PM35	300	360	600	0.0047 - 0.0079	0.0055 - 0.0098	0.0063 - 0.0110	0.0063 - 0.0118
K	1 Gray Cast Iron	120–290	HP	PM35	360	600	840	0.0055 - 0.0102	0.0063 - 0.0118	0.0071 - 0.0126	0.0079 - 0.0142
	2 Low- and Medium-Strength Ductile Irons (Nodular) and Compacted Graphite Irons	130–260	HP	PM35	300	540	780	0.0055 - 0.0102	0.0063 - 0.0118	0.0071 - 0.0126	0.0079 - 0.0142
	3 High-Strength Ductile Irons and Austempered Ductile Iron	180–350	HP	PM35	300	510	720	0.0055 - 0.0102	0.0063 - 0.0118	0.0071 - 0.0126	0.0079 - 0.0142
N	1 Wrought Aluminum	-	HA	HN25	750	1050	1500	0.0051 - 0.0071	0.0059 - 0.0079	0.0063 - 0.0110	0.0067 - 0.0118
	2 Low-Silicon Aluminum Alloys and Magnesium Alloys	-	HA	HN25	450	900	1350	0.0051 - 0.0071	0.0059 - 0.0079	0.0063 - 0.0110	0.0067 - 0.0118
	3 High-Silicon Aluminum Alloys and Magnesium Alloys	-	HA	HN25	240	360	450	0.0047 - 0.0067	0.0055 - 0.0083	0.0063 - 0.0091	0.0063 - 0.0094
S	3 Nickel-Based, Heat-Resistant Alloys	160-450	HL	PM35	60	90	135	0.0055 - 0.0083	0.0063 - 0.0094	0.0071 - 0.0102	0.0079 - 0.0118
	4 Titanium and Titanium Alloys	300-400	HL	PM35	105	120	195	0.0055 - 0.0083	0.0063 - 0.0094	0.0071 - 0.0102	0.0079 - 0.0118

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 For 5 X D, diameter range 0.969 – 2.5" (inserts sizes D to H), it is highly recommended to start with feed and speed values reduced by 15% less than above data.
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Speeds and Feeds



Feed Rate, Per Revolution (in/min)
$v_f = f_n \cdot n$

Feed Per Revolution (in/rev)
$f_n = \frac{v_f}{n}$

Cutting Speed (ft/min)
$v_c = \frac{\pi \cdot D_{tool} \cdot n}{12}$

Spindle Speed (rev/min)
$n = \frac{v_c \cdot 12}{\pi \cdot D_{tool}}$

Material Removal Rate (in ³ /min)
$MMR = D_{tool} \cdot f_n \cdot v_c \cdot 3$

Imperial

Symbol	Definition	Unit
V_f	Feed rate	in/min
f_n	Feed per revolution	in/rev
V_c	Cutting speed	ft/min (SFM)
n	Spindle speed	rev/min (RPM)
D_{tool}	Tool cutting diameter	in
MMR	Material removal rate	(in ³ /min)
Z	Number of teeth/flutes	

Insert Chip Groove

HP	HM	HA	HL
			
P K	P M K	N	P M S
First choice for machining steel, cast iron, and short chipping materials. Suitable for severe cutting conditions.	First choice for stainless steel. Suitable for deep drilling and operations where low power consumption is required.	First choice for aluminum and non-ferrous materials.	Ideal for long chipping materials.

Speeds and Feeds



Indexable Drill Body		Insert Selection															
Part #	Description	Steel						Stainless Steel				Cast Iron		Aluminum		High-Temp Alloys	
		P0-P1		P2-P4		P5-P6		M1-M2		M3		K1-K3		N1-N3		S3-S4	
		Center	Periphery	Center	Periphery	Center	Periphery	Center	Periphery	Center	Periphery	Center	Periphery	Center	Periphery	Center	Periphery
01-0022	HID3-.750-1.00-2C	02-0045	02-0044	02-0029	02-0028	02-0037	02-0036	02-0045	02-0044	02-0037	02-0036	02-0029	02-0028	02-0052	02-0056	02-0045	02-0044
01-0023	HID3-.875-1.00-2C	02-0045	02-0044	02-0029	02-0028	02-0037	02-0036	02-0045	02-0044	02-0037	02-0036	02-0029	02-0028	02-0052	02-0056	02-0045	02-0044
01-0024	HID3-1.000-1.00-2D	02-0047	02-0046	02-0031	02-0030	02-0039	02-0038	02-0047	02-0046	02-0039	02-0038	02-0031	02-0030	02-0053	02-0057	02-0047	02-0046
01-0025	HID3-1.125-1.25-2D	02-0047	02-0046	02-0031	02-0030	02-0039	02-0038	02-0047	02-0046	02-0039	02-0038	02-0031	02-0030	02-0053	02-0057	02-0047	02-0046
01-0026	HID3-1.250-1.25-2E	02-0049	02-0048	02-0033	02-0032	02-0041	02-0040	02-0049	02-0048	02-0041	02-0040	02-0033	02-0032	02-0054	02-0058	02-0049	02-0048
01-0027	HID3-1.375-1.25-2E	02-0049	02-0048	02-0033	02-0032	02-0041	02-0040	02-0049	02-0048	02-0041	02-0040	02-0033	02-0032	02-0054	02-0058	02-0049	02-0048
01-0028	HID3-1.500-1.50-2F	02-0051	02-0050	02-0035	02-0034	02-0043	02-0042	02-0051	02-0050	02-0043	02-0042	02-0035	02-0034	02-0055	02-0059	02-0051	02-0050
01-0029	HID3-1.625-1.50-2F	02-0051	02-0050	02-0035	02-0034	02-0043	02-0042	02-0051	02-0050	02-0043	02-0042	02-0035	02-0034	02-0055	02-0059	02-0051	02-0050
01-0030	HID3-1.750-1.50-2F	02-0051	02-0050	02-0035	02-0034	02-0043	02-0042	02-0051	02-0050	02-0043	02-0042	02-0035	02-0034	02-0055	02-0059	02-0051	02-0050
01-0031	HID5-.750-1.00-2C	02-0045	02-0044	02-0029	02-0028	02-0037	02-0036	02-0045	02-0044	02-0037	02-0036	02-0029	02-0028	02-0052	02-0056	02-0045	02-0044
01-0032	HID5-.875-1.00-2C	02-0045	02-0044	02-0029	02-0028	02-0037	02-0036	02-0045	02-0044	02-0037	02-0036	02-0029	02-0028	02-0052	02-0056	02-0045	02-0044
01-0033	HID5-1.000-1.00-2D	02-0047	02-0046	02-0031	02-0030	02-0039	02-0038	02-0047	02-0046	02-0039	02-0038	02-0031	02-0030	02-0053	02-0057	02-0047	02-0046
01-0034	HID5-1.125-1.25-2D	02-0047	02-0046	02-0031	02-0030	02-0039	02-0038	02-0047	02-0046	02-0039	02-0038	02-0031	02-0030	02-0053	02-0057	02-0047	02-0046
01-0035	HID5-1.250-1.25-2E	02-0049	02-0048	02-0033	02-0032	02-0041	02-0040	02-0049	02-0048	02-0041	02-0040	02-0033	02-0032	02-0054	02-0058	02-0049	02-0048
01-0036	HID5-1.375-1.25-2E	02-0049	02-0048	02-0033	02-0032	02-0041	02-0040	02-0049	02-0048	02-0041	02-0040	02-0033	02-0032	02-0054	02-0058	02-0049	02-0048
01-0037	HID5-1.500-1.50-2F	02-0051	02-0050	02-0035	02-0034	02-0043	02-0042	02-0051	02-0050	02-0043	02-0042	02-0035	02-0034	02-0055	02-0059	02-0051	02-0050

Insert Size	Tool Diameter (in)	2 X D / 3 X D			4 X D			5 X D		
		X-Offset Value Max	D1MAX Value	Hole Tolerance	X-Offset Value Max	D1MAX Value	Hole Tolerance	X-Offset Value Max	D1MAX Value	Hole Tolerance
A	0.473 - 0.531	0.020	D1MIN + 0.039	+/- 0.008	0.020	D1MIN + 0.039	+/- 0.014	-	-	+/- 0.014
B	0.563 - 0.734	0.020	D1MIN + 0.039	+/- 0.008	0.020	D1MIN + 0.039	+/- 0.014	-	-	+/- 0.014
C	0.750 - 0.938	0.020	D1MIN + 0.039	+/- 0.008	0.020	D1MIN + 0.039	+/- 0.014	-	-	+/- 0.014
D	0.969 - 1.156	0.031	D1MIN + 0.063	+/- 0.008	0.031	D1MIN + 0.039	+/- 0.014	-	-	+/- 0.014
E	1.188 - 1.438	0.031	D1MIN + 0.063	+/- 0.008	0.031	D1MIN + 0.039	+/- 0.014	-	-	+/- 0.014
F	1.469 - 1.750	0.031	D1MIN + 0.063	+/- 0.010	0.031	D1MIN + 0.039	+/- 0.015	-	-	+/- 0.015
G	1.813 - 2.219	0.039	D1MIN + 0.079	+/- 0.010	0.031	D1MIN + 0.039	+/- 0.015	-	-	+/- 0.015
H	2.250 - 2.500	0.039	D1MIN + 0.079	+/- 0.011	0.031	D1MIN + 0.039	+/- 0.017	-	-	+/- 0.017

NOTE: Indexable drill bodies require both periphery and center inserts. The styles are not interchangeable. Remember to order both periphery and center inserts.
D1MAX is an achievable diameter using x-offset.