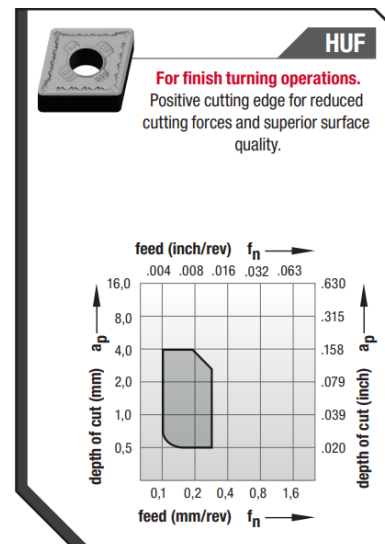
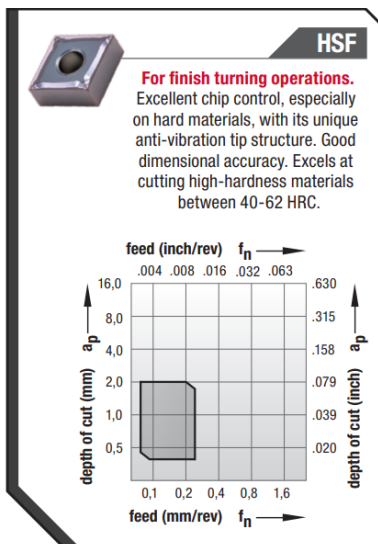
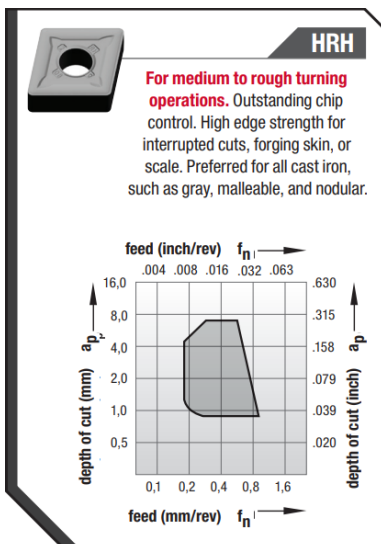
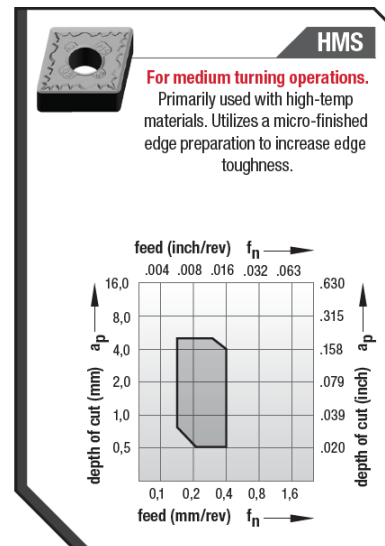
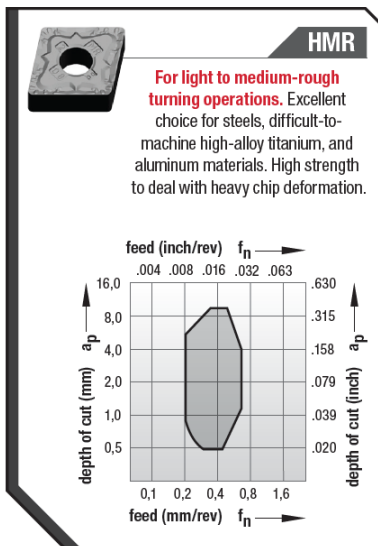
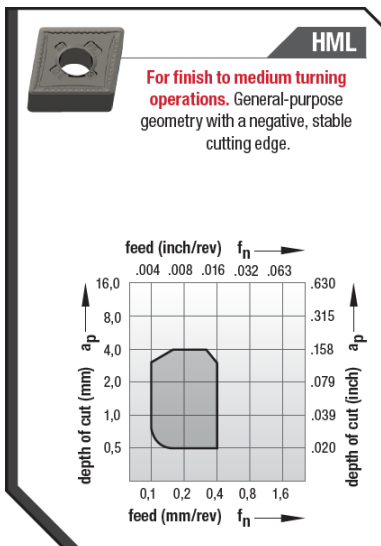
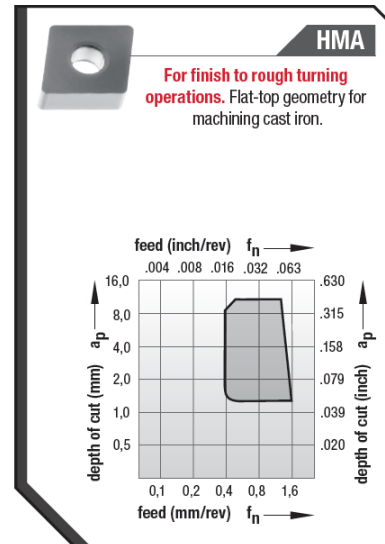
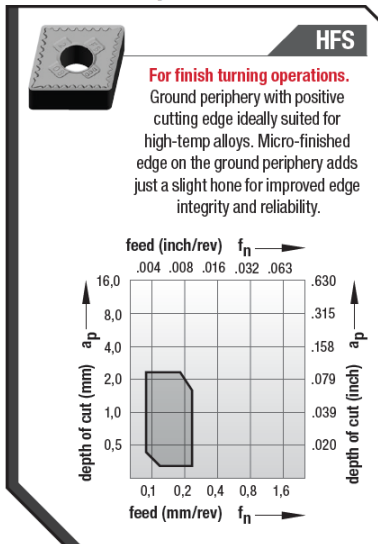
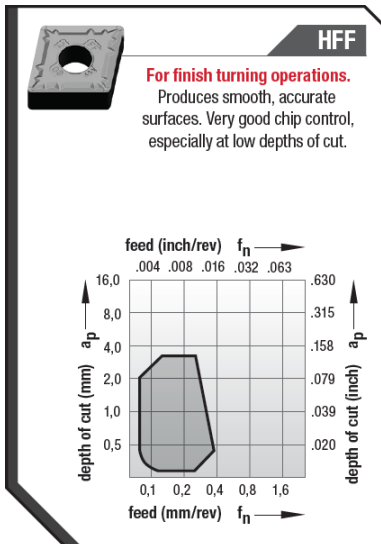


Speeds and Feeds



Chipbreakers

Turning Inserts - Negative

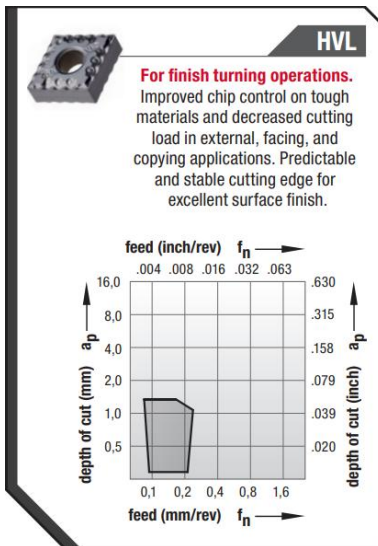
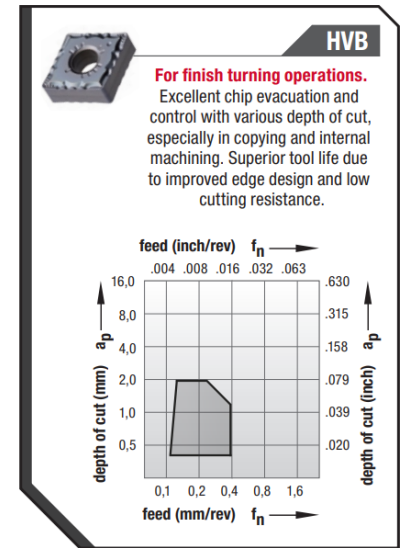
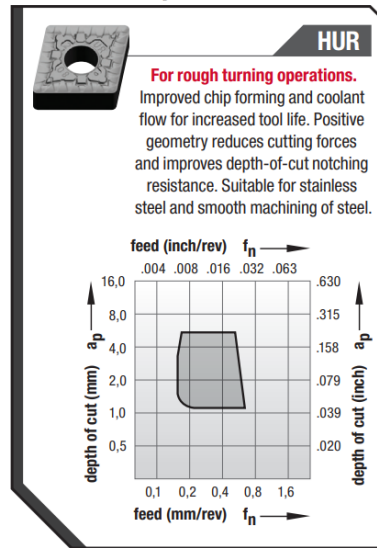
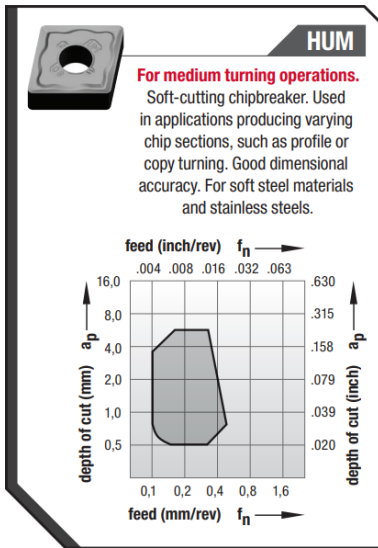


Speeds and Feeds



Chipbreakers

Turning Inserts - Negative

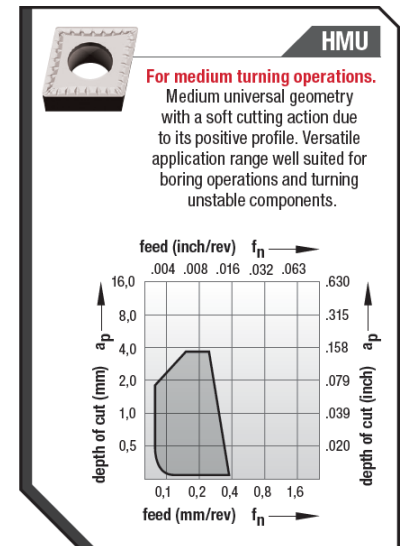
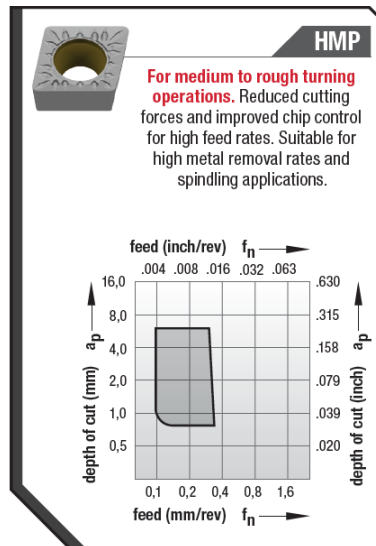
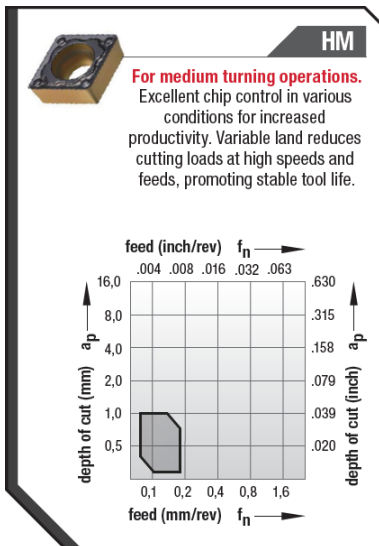
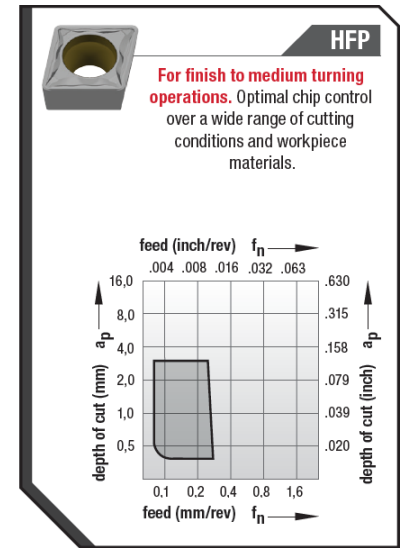
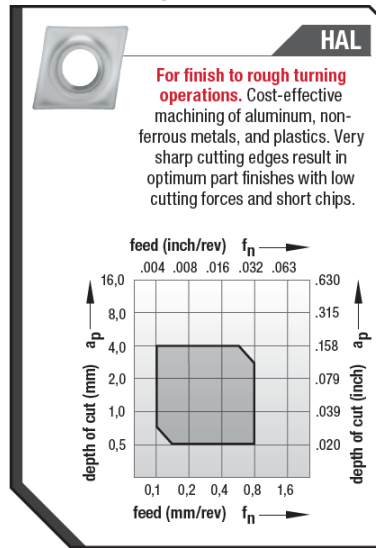
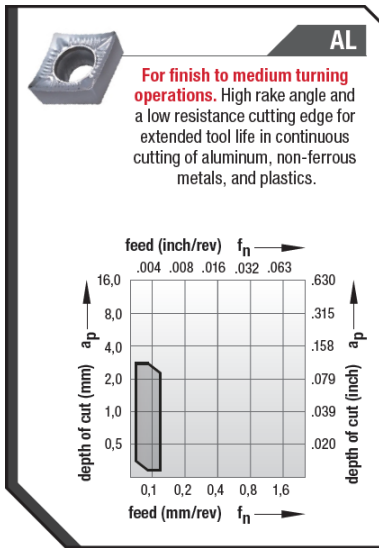


Speeds and Feeds



Chipbreakers

Turning Inserts - Positive



Grades

Speed - m/min (ft/min) Starting Conditions 

Material Group	Grade	135 (450)	180 (600)	225 (800)	275 (900)	320 (1050)	360 (1200)	410 (1350)	455 (1500)	495 (1650)	m/min	ft/min		
P0/P1	HTP15				⊕							395	1295	
	HTP25				⊕								275	900
	HTM15				⊕							350	1150	
	HTM25	⊕									210	690		
	HTK10				⊕						330	1085		
	HTK20				⊕						285	935		
	HTS10				⊕						280	920		
	HTS25				⊕								225	740
	HTS35	⊕									210	690		

Speed - m/min (ft/min) Starting Conditions 

Material Group	Grade	135 (450)	180 (600)	225 (800)	275 (900)	320 (1050)	360 (1200)	410 (1350)	455 (1500)	495 (1650)	m/min	ft/min
P2	HTP15	⊕									265	870
	HTP25	⊕									195	640
	HTM15	⊕									265	870
	HTM25	⊕									210	690
	HTK10	⊕									240	785
	HTK20	⊕									205	675
	HTS10	⊕									200	655
	HTS25	⊕									170	560
	HTS35	⊕									150	490

Speed - m/min (ft/min) Starting Conditions ⊕

[illegible]Speed - m/min (ft/min) Starting Conditions [illegible]Speed - m/min (ft/min) Starting Conditions

Material Group	Grade	120 (400)	150 (500)	180 (600)	210 (700)	240 (800)	270 (900)	300 (1000)	330 (1100)	360 (1200)	m/min	ft/min	
P5	HTP15			⊕							215	705	
	HTP25		⊕								195	640	
	HTM15			⊕							195	640	
	HTM25	⊕										135	445
	HTK10			⊕							220	720	
	HTK20		⊕								200	655	
	HTS10		⊕								200	655	
	HTS25	⊕										150	490
	HTS35	⊕										135	445

Speed - m/min (ft/min) Starting Conditions

Material Group	Grade	105 (350)	135 (450)	165 (550)	195 (650)	225 (750)	255 (850)	285 (950)	315 (1050)	345 (1150)	m/min	ft/min	
P6	HTP15		⊕								180	590	
	HTP25		⊕								150	490	
	HTM15		⊕								160	525	
	HTM25	⊕										115	375
	HTK10		⊕									190	625
	HTK20		⊕								155	510	
	HTS10		⊕								150	490	
	HTS25		⊕									125	410
	HTS35	⊕										105	345

Speeds and Feeds



Grades

Austenitic Stainless Steel (180 HB)											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	90 (300)	135 (450)	180 (600)	225 (800)	270 (900)	315 (1050)	360 (1200)	405 (1350)	450 (1500)	m/min	ft/min
M1	HTM15		⊕								180	590
	HTM25		⊕								150	490
	HTS10			⊕							215	705
	HTS25			⊕							180	590
	HTS35		⊕								120	395
	HTSU10		⊕								140	460

Ferritic/Martensitic Stainless Steel Mixture (Duplex) (200 HB)											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	90 (300)	135 (450)	180 (600)	225 (800)	270 (900)	315 (1050)	360 (1200)	405 (1350)	450 (1500)	m/min	ft/min
M2	HTM15		⊕								165	540
	HTM25		⊕								140	460
	HTS10			⊕							200	655
	HTS25			⊕							165	540
	HTS35		⊕								105	345
	HTSU10		⊕								130	425
	HTH05		⊕								100	325

Martensitic Stainless Steel (240 HB)											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	90 (300)	135 (450)	180 (600)	225 (800)	270 (900)	315 (1050)	360 (1200)	405 (1350)	450 (1500)	m/min	ft/min
M3	HTM15		⊕								150	490
	HTM25		⊕								120	395
	HTS10			⊕							185	605
	HTS25			⊕							150	490
	HTS35		⊕								90	295
	HTSU10		⊕								120	395
	HTH05		⊕								100	325

Grey Cast Iron								Speed - m/min (ft/min)				Starting Conditions		⊕
Material Group	Grade	60 (200)	180 (600)	305 (1000)	430 (1400)	550 (1800)	675 (2200)	800 (2600)	920 (3000)	1040 (3400)	1160 (3800)	m/min	ft/min	
K1	HTP15		⊕									285	935	
	HTP25		⊕									255	835	
	HTK10			⊕								450	1475	
	HTK20			⊕								300	985	
	HTS25		⊕									180	590	

Ductile, Compacted Graphite, and Malleable Cast Irons (<600 MPa)											Speed - m/min (ft/min)		Starting Conditions		⊕
Material Group	Grade	90 (300)	135 (450)	180 (600)	225 (750)	275 (900)	320 (1050)	360 (1200)	410 (1350)	460 (1500)	500 (1650)	m/min	ft/min		
K2	HTP15				⊕							215	705		
	HTP25				⊕							190	625		
	HTK10					⊕							360	1180	
	HTK20			⊕							240	785			
	HTS10		⊕									200	655		
	HTS25		⊕									160	525		

Ductile, Malleable, and Austempered Cast Irons (>600 MPa)											Speed - m/min (ft/min)		Starting Conditions		⊕
Material Group	Grade	90 (300)	135 (450)	180 (600)	225 (750)	275 (900)	320 (1050)	360 (1200)	410 (1350)	460 (1500)	500 (1650)	m/min	ft/min		
K3	HTP15		⊕									190	625		
	HTP25		⊕									170	560		
	HTK10		⊕									240	785		
	HTK20		⊕									210	690		
	HTS10		⊕									150	490		
	HTS25		⊕									135	445		
	HTH05	⊕											100	325	

Wrought Aluminum						Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	250 (800)	500 (1600)	750 (2400)	1000 (3200)	m/min	ft/min
N1	HTSU10	⊕				490	1605
	HN25		⊕			580	1900

Low-Silicon Aluminum Alloys and Magnesium Alloys (Si<12.2%)						Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	250 (800)	500 (1600)	750 (2400)	1000 (3200)	m/min	ft/min
N2	HTSU10	⊕				490	1605
	HN25		⊕			580	1900

Copper-, Brass-, Zinc-Based on a Machinability Index of 70–100						Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	250 (800)	500 (1600)	750 (2400)	1000 (3200)	m/min	ft/min
N4	HTSU10	⊕				260	850
	HN25		⊕			470	1540

Speeds and Feeds



Grades

Nylon, Plastics, Rubbers, Phenolics, Resins, Fiberglass

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	250 (800)	500 (1600)	750 (2400)	1000 (3200)	m/min	ft/min
N5	HTSU10	⊕				105	345
	HN25	⊕				105	345

Tin Alloys, Cast: ASTM 823, Alloys 1, 2, 3, 11

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	250 (800)	500 (1600)	750 (2400)	1000 (3200)	m/min	ft/min
N6	HTSU10	⊕				180	590
	HN25	⊕				180	590

Iron-Based, Heat-Resistant Alloys (135–320 HB) (≤34 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
S1	HTM15		⊕									55	180
	HTM25		⊕									40	130
	HTS10		⊕									55	180
	HTS25		⊕									40	130
	HTS35		⊕									40	130
	HTSU10		⊕									30	100
	HTH05				⊕							100	325

Cobalt-Based, Heat-Resistant Alloys (150–425 HB) (≤45 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
S2	HTM15		⊕									60	195
	HTM25		⊕									30	100
	HTS10		⊕									60	195
	HTS25		⊕									30	100
	HTS35		⊕									30	100
	HTSU10		⊕									35	115
	HTH05				⊕							100	325

Nickel-Based, Heat-Resistant Alloys (140–475 HB) (≤48 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
S3	HTM15			⊕								70	230
	HTM25		⊕									40	130
	HTS10			⊕								70	230
	HTS25		⊕									40	130
	HTS35		⊕									40	130
	HTSU10		⊕									40	130
	HTH05				⊕							100	325

Titanium and Titanium Alloys (110–450 HB) (≤48 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
S4	HTM15			⊕								70	230
	HTM25		⊕									55	180
	HTS35		⊕									55	180
	HTSU10		⊕									45	150
	HTH05				⊕							100	325

Hardened Steel (>55 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
H1	HTH05				⊕							100	325

Hardened Steel (≤60 HRC)

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
H2	HTH05				⊕							100	325

Chilled Cast Iron

Speed - m/min (ft/min) Starting Conditions ⊕

Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min
H4	HTH05				⊕							100	325



Speeds and Feeds



Cermet Grades

Low-Carbon (<0.3% C) and Free-Machining Steels											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	135 (450)	180 (600)	225 (800)	275 (900)	320 (1050)	360 (1200)	410 (1350)	455 (1500)	495 (1650)	m/min	ft/min
P0/P1	HCP10C					⊕					350	1150
	HCTP15					⊕					400	1300

Low-Carbon (<0.3% C) and Free-Machining Steels											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	135 (450)	180 (600)	225 (800)	275 (900)	320 (1050)	360 (1200)	410 (1350)	455 (1500)	495 (1650)	m/min	ft/min
P0/P1	HCP10C				⊕						300	980
	HCTP15				⊕						320	1050

Low-Carbon (<0.3% C) and Free-Machining Steels											Speed - m/min (ft/min) Starting Conditions ⊕	
Material Group	Grade	135 (450)	180 (600)	225 (800)	275 (900)	320 (1050)	360 (1200)	410 (1350)	455 (1500)	495 (1650)	m/min	ft/min
P0/P1	HCP10C				⊕						270	885
	HCTP15				⊕						285	950

Grey Cast Iron								Speed - m/min (ft/min)				Starting Conditions		⊕
Material Group	Grade	60 (200)	180 (600)	305 (1000)	430 (1400)	550 (1800)	675 (2200)	800 (2600)	920 (3000)	1040 (3400)	1160 (3800)	m/min	ft/min	
K1	HCP10C		⊕									270	885	
	HCTP15		⊕									285	950	

CBN Grades

Hardened Steel (>55 HRC)									Speed - m/min (ft/min)			Starting Conditions		⊕
Material Group	Grade	15 (50)	45 (150)	75 (250)	105 (350)	140 (450)	170 (550)	200 (650)	230 (750)	290 (950)	310 (1050)	m/min	ft/min	
H1	CBNH10C					⊕						170	560	

Feed	Depth of Cut (DOC)
0.05 - 0.3 mm/rev (0.002 - 0.012 in/rev)	0.05 - 0.3 mm (0.002 - 0.012 in)



Speeds and Feeds



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

Feed Rate, Per Tooth (mm/min)
$v_f = f_z \cdot n \cdot Z$

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

Feed Per Tooth (mm)
$f_z = \frac{v_f}{n \cdot Z}$

Cutting Speed (m/min)
$v_c = \frac{\pi \cdot D_{tool} \cdot n}{1000}$

Spindle Speed (rev/min)
$n = \frac{v_c \cdot 1000}{\pi \cdot D_{tool}}$

Material Removal Rate (cm ³ /min)
$MRR = \frac{a_p \cdot a_e \cdot v_f}{1000}$

Metric

Symbol	Definition	Unit
V_f	Feed rate	mm/min
f_n	Feed per revolution	mm/rev
f_z	Feed per tooth	mm
V_c	Cutting speed	m/min (SMM)
n	Spindle speed	rev/min (RPM)
D_{tool}	Tool cutting diameter	mm
MRR	Material removal rate	(cm ³ /min)
a_e	Radial depth of cut	mm
a_p	Axial depth of cut	mm
Z	Number of teeth/flutes	

Speeds and Feeds



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

Feed Rate, Per Tooth (in/min)
$v_f = f_z \cdot n \cdot Z$

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

Feed Per Tooth (in)
$f_z = \frac{v_f}{n \cdot Z}$

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)
$MRR = a_p \cdot a_e \cdot v_f$

Inch

Symbol	Definition	Unit
v_f	Feed rate	in/min
f_n	Feed per revolution	in/rev
f_z	Feed per tooth	in
v_c	Cutting speed	ft/min (SFM)
n	Spindle speed	rev/min (RPM)
D_{tool}	Tool cutting diameter	in
MRR	Material removal rate	(in ³ /min)
a_e	Radial depth of cut	in
a_p	Axial depth of cut	in
Z	Number of teeth/flutes	