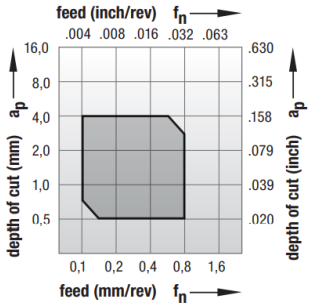
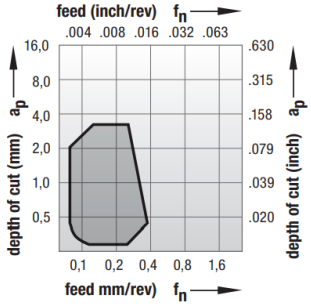
Speeds and Feeds

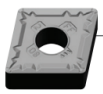
Chipbreakers



HAL

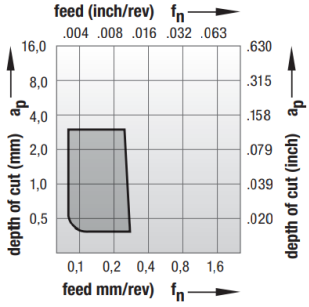
For cost-effective machining of aluminum, non-ferrous metals, and plastics. Extremely sharp cutting edges result in optimum part finishes with low cutting forces and short chips.

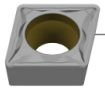




HFF

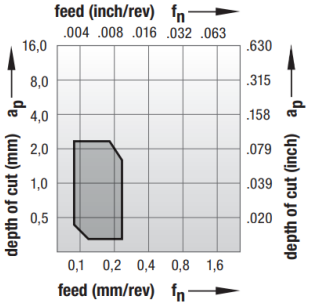
For finish turning operations, producing smooth, accurate surfaces. Very good chip control, especially at low depths of cut.





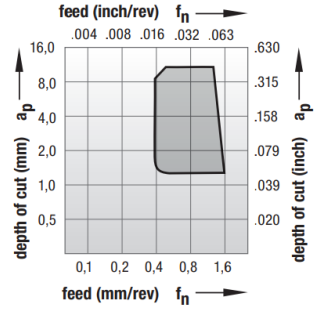
HFP

For finish to medium turning operations, with optimal chip control over a wide range of cutting conditions and workpiece materials.



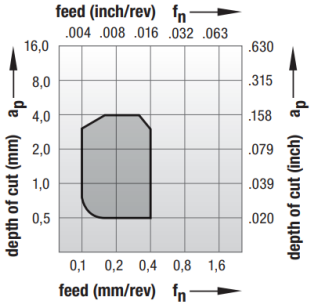
HFS

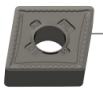
For finish turning operations. Ground periphery with positive cutting edge ideally suited for high-temp alloys. Micro-finished edge on the ground periphery adds just a slight hone for improved edge integrity and reliability.



HMA

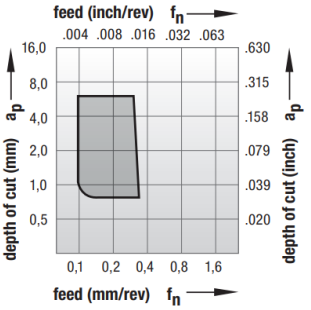
For finish to rough turning operations. Flat-top geometry for machining cast iron.

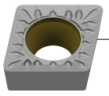




HML

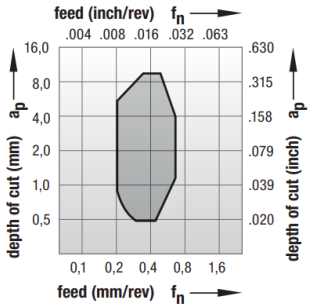
For finish to medium turning operations, with a negative, stable cutting edge.





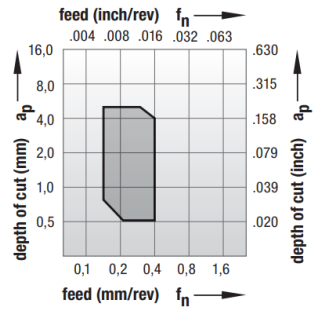
HMP

For medium to rough turning operations, with reduced cutting forces and improved chip control for high feed rates. Suitable for high metal removal rates and spindling applications.



HMR

For light to medium rough-turning operations. Excellent choice for steels, difficult-to-machine high-alloy titanium, and aluminum materials. High strength to deal with heavy chip deformation.

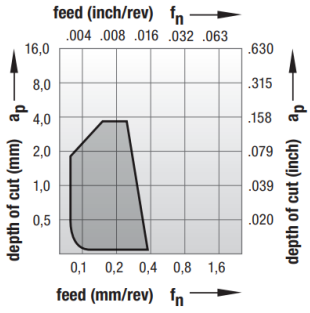


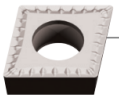
HMS

For medium turning operations. Primarily used with high-temp materials. Utilizes a micro-finished edge preparation to increase edge toughness.

Speeds and Feeds

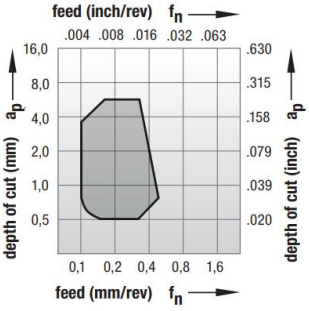
Chipbreakers





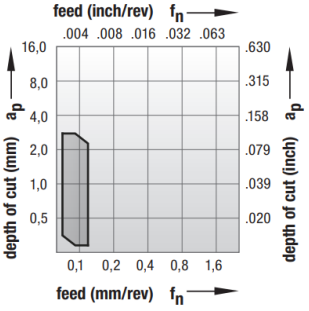
HMU

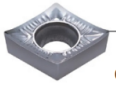
For medium turning operations. Medium universal geometry with a soft cutting action due to its positive profile. Versatile application range well suited for boring operations and turning unstable components.



HUM

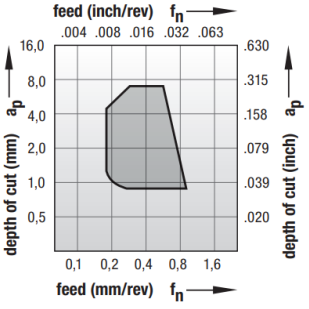
For medium turning operations, with a soft-cutting chipbreaker. Used in applications producing varying chip sections, such as profile or copy turning. Good dimensional accuracy. For soft steel materials and stainless steels.





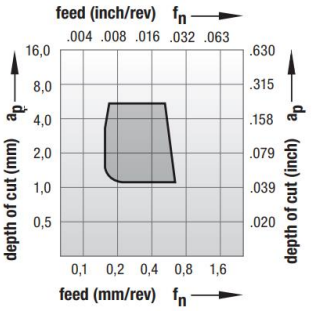
AL

For finish to medium turning operations. High rake angle and a low resistance cutting edge for extended tool life in continuous cutting of aluminum, non-ferrous metals, and plastics.



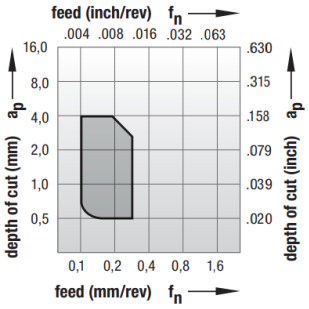
HRH

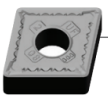
For medium to rough turning operations. Outstanding chip control. High edge strength for interrupted cuts, forging skin, or scale. Preferred for all cast iron, such as gray, malleable, and nodular.



HUR

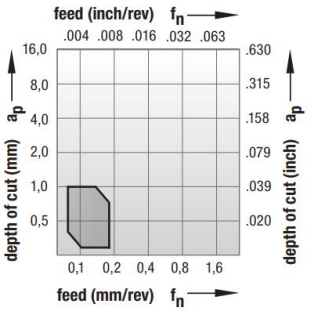
For rough turning operations. Improved chip forming and coolant flow for increased tool life. Positive geometry reduces cutting forces and improves depth-of-cut notching resistance. Suitable for stainless steel and smooth machining of steel.

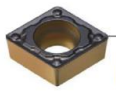




HUF

For finish turning operations, with a positive cutting edge for reduced cutting forces and superior surface quality.





HM

For medium turning operations. Excellent chip control in various conditions for increased productivity. Variable land reduces cutting loads at high speeds and feeds, promoting stable tool life.

Speeds and Feeds

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	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

Alloy Steels and Tool Steels (340–450 HB) (36–48 HRC) — Speed - m/min (ft/min) — Starting Conditions ⊕

Material Group	Grade	60 (200)	90 (300)	120 (400)	150 (500)	180 (600)	210 (700)	240 (800)	270 (900)	300 (1000)	m/min	ft/min
P4	HTP15				⊕						145	475
	HTP25			⊕							105	345
	HTM15				⊕						130	425
	HTM25		⊕								95	310
	HTK10				⊕						140	460
	HTK20			⊕							110	360
	HTS10			⊕							110	360
	HTS25				⊕						145	475
	HTS35		⊕								95	310

Medium- and High-Carbon Steels (>0.3% C) — 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

Ferritic, Martensitic, and PH Stainless Steels (≤330 HB) (≤35 HRC) — 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

Alloy Steels and Tool Steels (≤330 HB) (≤35 HRC) — 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
P3	HTP15		⊕								190	625
	HTP25		⊕								155	510
	HTM15		⊕								170	560
	HTM25	⊕									130	425
	HTK10		⊕								170	560
	HTK20		⊕								160	525
	HTS10		⊕								155	510
	HTS25		⊕								155	510
	HTS35	⊕									120	395

Ferritic, Martensitic, and PH Stainless Steels (340–450 HB) (36–48 HRC) — 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

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

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

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

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

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

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

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

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

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

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

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

There are many variables that go into choosing the correct insert for your turning operations: insert shape, geometry, grade, and more.

Choose the insert style (shape and size) based on the features of the part and the desired depth of cut. A larger nose radius is stronger, but requires more machine power, and increases the tendency for vibration. A smaller nose radius increases the access to fine part features, but has a weaker cutting edge.

Choose the chipbreaker (geometry) based on the selected machining operation: finishing, medium, or roughing. Roughing with high depths of cut and feed rates requires an insert with a stronger cutting edge. Finishing operations with light depths of cut and lower feed rates produce lower cutting forces, so cutting-edge strength is not as important. Medium turning operations, with a wide range of depths of cut and feed rate, require a more versatile geometry.

Choose the insert grade (coatings) based on the type of material being cut, the specific machining operation (finishing, medium, roughing), and the cutting conditions (smooth, lightly interrupted, heavily interrupted). The insert grade and the chipbreaker complement each other to provide specific performance characteristics. A tougher grade can compensate for a cutting edge with less strength, while a more wear resistant grade can provide longer tool life on a stronger cutting edge.

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

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*
MMR	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	

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)
$MMR = \frac{a_p \cdot a_e \cdot v_f}{1000}$

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*
MMR	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	