

Strictly Confidential



Stainless

August, 2019



Types of Stainless Steels

- Austenitic Stainless
 - 316, 304 (304; 18-20Cr, 8-11Ni)
 - High corrosion resistance
 - Non-magnetic
 - Hardenable by cold work only (annealing; and may become magnetic if so)
- Ferritic Stainless
 - 434, 430 (430; 16-18Cr)
 - Magnetic
 - Hardenable by cold work (annealing) only, causing dimensional distortions
- Austenitisers: C, Ni, Mn, Cu
- Ferritisers: Si, Mo, W, Ti, Nb
- Martensitic Stainless
 - 420, 410 (410; 11-15Cr, 0.2Ti, 1Mn)
 - Heat treatable to achieve high hardness
 - Relatively easy to form



Types of Stainless Steels

- Precipitation Hardened
 - 13-8, 15-5, 17-4 (17-4; 17Cr, 4Ni, 3Cu, 0.3Nb)
 - High strength by adding Copper, Niobium, Aluminum
 - Precipitation aged (hardened) with minimal distortion
- Duplex
 - 2304 (Lean duplex; 23Cr, 4.8Ni, 0.3Mo)
 - 2205 (Standard duplex; 22Cr, 5.7Ni, 3.1Mo)
 - 2507 (Super duplex; 25Cr, 7Ni, 4Mo)
 - Microstructure 50% ferritic, 50% martensitic. Twice the strength of austenitic and ferritic stainless
 - High toughness down to -80°C
 - High chemical stability and corrosion resistance
 - Highest strength of any stainless at Sigma phase, but can be extremely brittle if heated to over 475°C (Gamma phase)

Types of Stainless Steels and how they machine

- Austenitic Stainless

- 316
- Lamellar chipflow adding high stress on microgeometry requiring dedicated stainless geometry
- Requires larger chip area to control/form chip
- Dedicated PVD stainless grades (CVD YG3030 may be used at elevated speed, but are more susceptible to flaking)
- Moderate to high speed (316; 500-800SFM [150-240m])



Lamellar chip flow, MR YG214 SS304

- Ferritic Stainless

- 430
- Continuous chipflow. Commonly steel geometries are suitable, but stainless geometries will work (although microgeometry may be too much causing excess force/load)
- Fairly easy to gain chip control
- CVD steel grades (YG3010/YG3020) allow for higher speed (430; 650-1000SFM [200-305m])

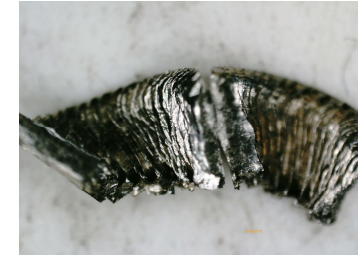
- Martensitic Stainless

- 410
- CVD if heat treated to manage elevated temperatures
- Strong microgeometry (ex. UG vs. UM, or use MM/MR)
- Fairly easy to gain chip control if heat treated. Otherwise, requires larger chip area
- Lower speed due to thermal generation (410; 300-400SFM [90-120m])

Types of Stainless Steels and how they machine

- Precipitation Hardened

- 17-4
- Lamellar chipflow. Dedicated stainless geometries with strong microgeometry
- High feed is a must to evacuate heat and gain chip control
- Combine tough geometry with wear resistant grade; ex. MR YG211
- Medium speed (17-4; 300-500SFM [90-150m] in soft state; 200-300SFM [60-90m] in hard state)



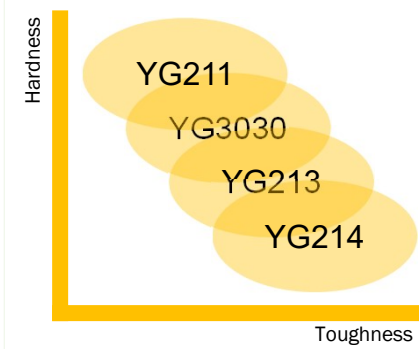
Lamellar chip flow, MM YG214 SS304

- Duplex

- 2205
- Requires strong geometry and tough grade; ex. MR YG214
- CVD may be used, but is susceptible to flaking
- Low speed (2205; 200-350SFM [60-105m])
- Medium to low feed rate due to strength of material (micro geometry load)

Turning Stainless Steel

Stainless Steel Grades



HARD ↑

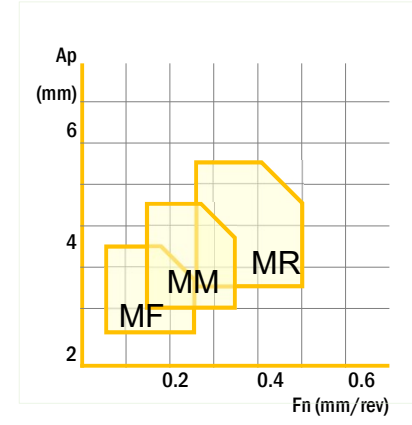
TOUGH ↓

NEW  **YG211** PVD M05-M20 S05-S25
Hard grade for Continuous Cut

 **YG3030** CVD P20-P35 M10-M30
CVD grade for High cutting speed

NEW  **YG213** PVD M25-M40 S25-S40
Tough grade for Roughing

NEW  **YG214** PVD M30-M50 S30-S50
Extremely Tough grade for Interrupted Cut



Chipbreakers



Milling Stainless

Milling Grades	P Steel				M Stainless Steel				K Cast Iron				N Non Ferrous Metals				S Heat Resistant Super Alloy				H Hardened Materials			
	05	15	25	35	05	15	25	35	05	15	25	35	05	15	25	35	05	15	25	35	05	15	25	35
YG602			602				602				602								602					
YG622			622								622													
YG712			712								712													
YG603			603				603																	
YG501			501								501													
YG500															500									

Milling Grades

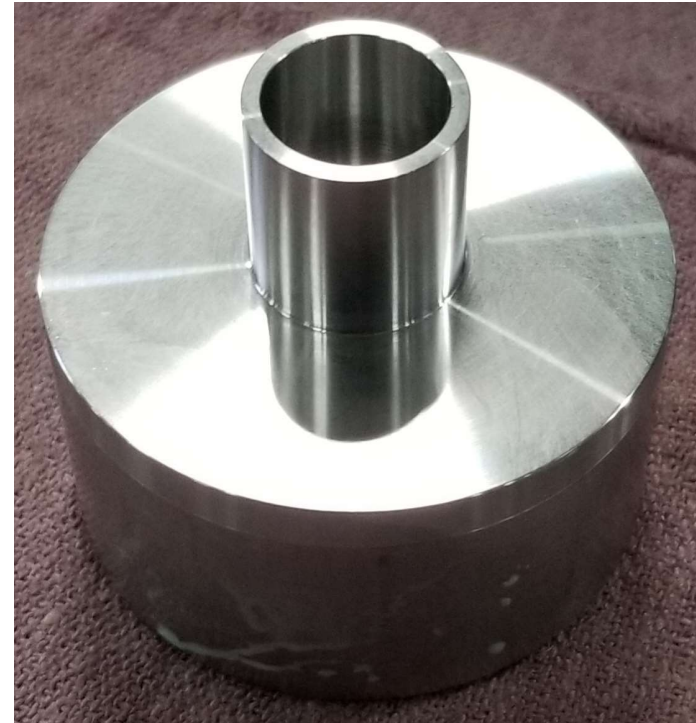
	NEW YG602 Multi-Purpose Grade	P20-P35 M20-M40 K20-K40 S15-S25		NEW YG603 for Stainless Steel	M30-M45 P30-P45
	NEW YG622 For High Alloyed Steels (Mold & Die)	P20-P40 K20-K40		NEW YG501 for Cast Iron	K05-K25 P05-P25
	NEW YG712 for Steels	P10-P30 K10-K30		NEW YG500 for Aluminum	N05-N35

Milling Chipbreakers

P	M	K	N	S	H	Chipbreaker	Application
			N			-AL	Aluminum
	M			S		-ST	Sharp Edge Sticky materials Stainless Steel & Super Alloys
P	M	K				General	General Application Alloy Steels
P		K				-TR	Reinforced Edge High Alloyed Steels & Cast Irons
P		K			H	..W	Hardened Materials Cast Irons

Success stories

Material:	304L
Hardness:	25 HrC
Starting \varnothing :	4" (101.6mm)
Diameter:	2.5" (63.5mm)
Vc	500 SFM (152m)
fn	0.010" (0.25mm)
Ap	0.100" (2.5mm)



Success stories

- Improved chip control
- Better surface finishing
- Reduced cost





Success stories

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Cutting Tools		YG-1		Current solution	
Inserts	Manufacturer	YG-1		Major competitor	
	Designation / Grade	CNMG432MF	YG213	CNMG432	M25
Holder	Designation	DCLNR164D			
	Shank size	1"		Same	
Cutting Condition	Cutting speed (vc)	500	SFM	500	SFM
	Feedrate(fn)	.010"	in/rev	.010"	in/rev
	Depth of cut(ap)	.100"	Inch	.100"	Inch
	Passes	8 passes		8 passes	
	Coolant	Synthetic		Synthetic	
Test Results					
Machining time (min)		1min 5 sec	min	1min 5 sec	min
Number of parts (pcs)		15	pcs	15	pcs
Type of wear		Flank wear		Excessive flank wear	

Success stories

- Superior chip control eliminating all issues
- Much improved surface finishing
- 60% lower tooling cost



Success stories

- Material: 13-8PH ~50HrC
- Background: Original information was ~30HrC, hence the higher speed. Looking at the chips, it was clear that this was much harder.
- MR YG211 doubled tool life and increased f_n
- 300-200SFM (90-60m), f_n 0.13”-.014” (0.33-0.36mm), A_p .060” (1.5mm)

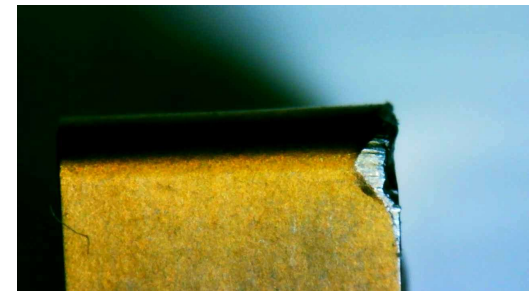
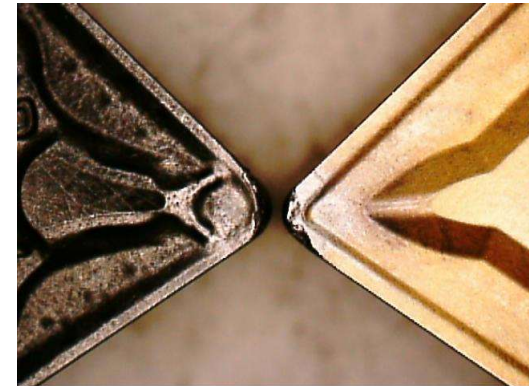
YG-1 USA								
Insert Geometry:		CNMG432-MR			Tool Holder: DCLNR204D			
Grade:		YG211/YG213						
		(SFM)	(IPR or FPT)		# of Pcs. or	(see Reverse Side Key)		
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	YG211	300	0.013	0.06	4.5"	0.1	Catastrophic	6/9
# of Pass/s	YG213	250	0.013	0.06	4.5"	0.2	Catastrophic	6/9
# of Pass/s	YG211	200	0.014	0.06	4.5"	1	Crater/Flank	6/9
# of Pass/s								
Results W/L	Please place comments here: -->			14 passes at aprox 14" long +1 part				
Competition								
Insert Geometry:		CNMG432			Tool Holder: DCLNR204D			
Grade:		M15						
		(SFM)	(IPR or FPT)		# of Pcs. or	(see Reverse Side Key)		
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	varies	200	0.013	0.06	4.5"	0.5	Crater/Flank	6/9
# of Pass/s								
# of Pass/s								
# of Pass/s								
Results W/L	Please place comments here: -->							



Success stories

- Material: Inconel 718 cast (aged)
- Background: Tier 1 Aerospace has used the competitor for year
- YG214 MR outperformed major competitor
- 80-100SFM (24-30m), fn .005-.008" (0.13-0.20mm), Ap .010-.030" (0.25-0.75mm)

YG-1 USA								
Insert Geometry:	CNMG432-MR				Tool Holder:			
Grade:	YG214							
	(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)		
	Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip	
# of Pass/s	1	80	0.008	0.03	1.5	1	flank	short
# of Pass/s	1	100	0.005	0.01	1.5	1	flank	short
# of Pass/s								
# of Pass/s								
Results W/L	Please place comments here: -->				Superior chip control and wear			
Competition								
Insert Geometry:	CNMG432				Tool Holder: DCLNR 164			
Grade:	S25							
	(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)		
	Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip	
# of Pass/s	100	0.005	0.01	1.5	1	Flank /chipping	tight string	
# of Pass/s	80	0.008	0.03	1.5	1	Flank /chipping	tight	
# of Pass/s								
# of Pass/s								
Results W/L	Please place comments here: -->							



Success stories

- Material: Inconel 718 cast (aged, interrupted)
- Component: 12" flange ring with 12 lugs
- Background: Tier 3 Aerospace Engine
- Using 100° corner, MR & MM outperformed major competitor
- 100SFM (30m), fn .004" (0.1mm), Ap .030" (0.75 mm)

YG-1 USA								
Insert Geometry:		CNMG 432 MR/MM			Tool Holder:			
Grade:		YG214						
		(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)	
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	2MR	100	0.004	0.03	1.5	2	flank	short
# of Pass/s	2MM	100	0.004	0.03	1.5	2	flank	short
# of Pass/s								
# of Pass/s								
Results W/L		Please place comments here: -->			Heavy interruptions			
face across 12 bosses with 100 deg corner .MR Ran with less load than the competition. The MM chip breaker ran with even less								
load with no more wear than the MR								
Competition								
Insert Geometry:		CNMG432			Tool Holder: DCLNR 164			
Grade:		M25						
		(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)	
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	varies	100	0.004	0.03	1.5	2	Flank /chipping	short
# of Pass/s								
# of Pass/s								
# of Pass/s								
Results W/L		Please place comments here: -->						

Success stories

- Material: Waspaloy forged (heavily interrupted)
- Component: 16" ring
- Background: Tier 3 Aerospace Engine
- Using 100° corner, MR outperformed major competitor
- 80SFM (24m), fn .008" (0.20mm), Ap .040" (1 mm)

YG-1 USA								
Insert Geometry:		CNMG 432 MR			Tool Holder:			
Grade:		YG214						
		(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)	
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	varies	80	0.008	0.04		4min	flank	open
# of Pass/s								
# of Pass/s								
# of Pass/s								
Results W/L		Please place comments here: -->			cut with less load and looked better than competitor			
Competition								
Insert Geometry:		CNMG 432			Tool Holder: DCLNR 164			
Grade:		S10						
		(SFM)	(IPR or FPT)			# of Pcs. or	(see Reverse Side Key)	
		Speed	Feed	D.O.C.	L.O.C.	Time in Cut	Type of Wear	Type of Chip
# of Pass/s	varies	80	0.008	0.04		4 min	chipping/flank	open
# of Pass/s								
# of Pass/s								
# of Pass/s								
Results W/L		Please place comments here: -->						



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