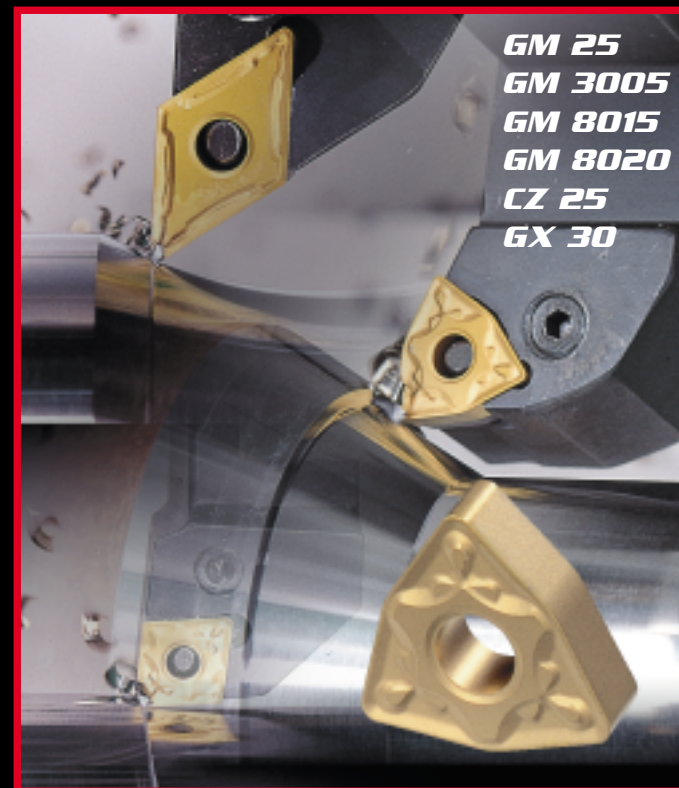


Turning Guide 2000



**HITACHI TOOL ENGINEERING
EUROPE GMBH**

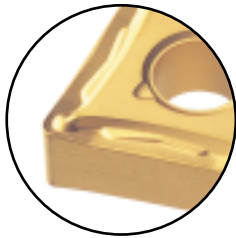
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At first, to select optimum insert.



THIS MANUAL, IS THE ADVICE BOOK WHICH CAN HELP TO DECIDE OPTIMUM INSERT AND THE CUTTING CONDITION. THIS WAS WRITTEN TO BE USED EASILY BY EVERYBODY.

1

MATERIAL



Steels

34P REFERENCE MATERIAL,
CARBON STEEL, ALLOY STEEL 180HB



Stainless Steels

35P REFERENCE MATERIAL,
AUSTENITIC TYPE STAINLESS STEEL 180HB



Cast Iron

35P REFERENCE MATERIAL
CAST IRON, DUCTILE CAST IRON 260HB

2

APPLICATION
RANGE



Finishing

UP TO 0,5MM DEPTH OF CUT



Light cutting

UP TO 0,5~1,5MM DEPTH OF CUT



Medium cutting

UP TO 1,5~4,0MM DEPTH OF CUT



Roughing (Heavy)

UP TO 4,0~7,0MM DEPTH OF CUT

3

TURNING
CONDITIONS



Continuous cutting

HIGH SPEED CUTTING, CONTINUOUS CUTTING, REGULAR DEPTH OF CUT, HIGH CLAMPING CUTTING



General cutting

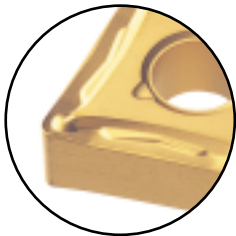
INTERRUPTED-LIGHT CUTTING, MIDDLE SPEED CUTTING, FORGING, CAST IRON CUTTING



Interrupted cutting

IRREGULAR DEPTH OF CUT, INTERRUPTED CUTTING, LOWSPEED CUTTING, LOW CLAMPING CUTTING

How to select optimum inserts on each material



FOLLOWING THREE CLASSIFIED
FIGURES FOR EACH MATERIAL, STEEL,
STAINLESS STEEL, CAST IRON, SHOWS
OPTIMUM CHIPBREAKER AND GRADE.

BASED ON FIRST RECOMMENDATION
IT´S POSSIBLE TO SELECT INSERTS
FOR EACH APPLICATION.

Recommendation				
Stable cutting General cutting Unstable cutting				
P S T E E L		CONTINUOUS CUTTING	GENERAL CUTTING	INTERRUPTED CUTTING
	F FINISHING	JE Type CZ25	 JE Type GM25	JE Type GM25
	F FINISHING	BE Type GM8015	 BE Type GM8020	BE Type GM25
	M MEDIUM	AE Type GM8015	 AE Type GM8020	AE Type GM25
	R ROUGHING	RE Type GM8015	 RE Type GM8020	RE Type GM25

		Recommendation		
		Stable cutting	General cutting	Unstable cutting
M		CONTINUOUS CUTTING	GENERAL CUTTING	INTERRUPTED CUTTING
				
	F FINISHING	JE Type CZ25	 JE Type GM25	JE Type GM25
	F FINISHING	SE Type GM25	 SE Type GM25	SE Type GM25
	M MEDIUM	DE Type GX30	 DE Type GX30	DE Type GX30
	R ROUGHING	AE Type GX30	 AE Type GX30	AE Type GX30

		Recommendation		
		Stable cutting	General cutting	Unstable cutting
K		CONTINUOUS CUTTING	GENERAL CUTTING	INTERRUPTED CUTTING
				
	F FINISHING	V Type GM3005	 V Type GM3005	No breaker GM3005
	M MEDIUM	V Type GM3005	 V Type GM8015	No breaker GM8015
	R ROUGHING	V Type GM3005	 RE Type GM8015	No breaker GM8015

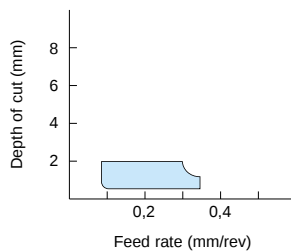


Selection 1. F

RECOMMENDED BREAKER

JE Type

FINISHING ON STEEL



RECOMMENDED GRADE

GM25



CONTINUOUS



GENERAL



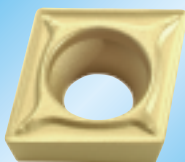
INTERRUPTED

JE



CZ25

JE



GM25

JE



GM25

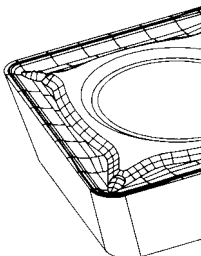
High Speed/Wear resistance

Toughness/Low Speed

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)	
		CZ25	GM25
0,5~2,0	0,1~0,3	100~200	150~200

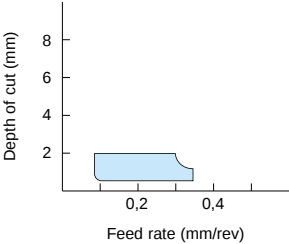


JE Breaker	ITEM CODE (DESIGNATION)		 CZ25	 GM25	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)			
	CCMT 060202-JE		☐	☒	
	060204-JE		☐	☒	
	09T302-JE		☐	☒	
	09T304-JE		☐	☒	
	09T308-JE		☐	☒	
	DCMT 070204-JE		☐	☒	
	070208-JE		☐	☒	
	11T302-JE		☐	☒	
	11T304-JE		☐	☒	
	11T308-JE		☐	☒	
	SCMT 09T304-JE		☐	☒	
	09T308-JE		☐	☒	
	TCMT 090202-JE		☐	☒	
	090204-JE		☐	☒	
	110202-JE		☐	☒	
	110204-JE		☐	☒	
	110208-JE		☐	☒	
	16T304-JE		☐	☒	
	16T308-JE		☐	☒	
	TPMR 110308-JE		☐	☒	
	160304-JE		☐	☒	
	160308-JE		☐	☒	
	VBMT 110304-JE		☐	☒	
	110308-JE		☐	☒	
	160404-JE		☐	☒	
	160408-JE		☐	☒	
	VCMT 160404-JE		☐	☒	
	160408-JE		☐	☒	



Selection 2. F

RECOMMENDED BREAKER **BE Type** FINISHING ON STEEL



RECOMMENDED GRADE **GM8020**



CONTINUOUS



GENERAL



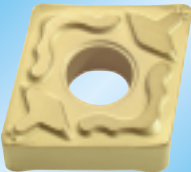
INTERRUPTED

BE



GM8015

BE



GM8020

BE



GM25

High Speed/Wear resistance

Toughness/Low Speed

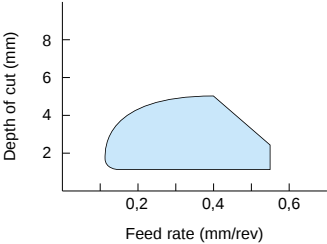
RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)		
		GM8015	GM8020	GM25
0,3~1,5	0,1~0,3	180~300	150~250	100~200



Selection 3. M

RECOMMENDED BREAKER AE Type MEDIUM CUTTING ON STEEL



RECOMMENDED GRADE GM8020



CONTINUOUS



GENERAL



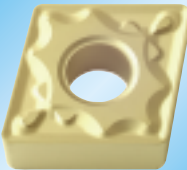
INTERRUPTED

AE



GM8015

AE



GM8020

AE



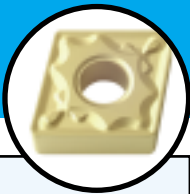
GM25

High Speed/Wear resistance

Toughness/Low Speed

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)		
		GM8015	GM8020	GM25
1,0~5,0	0,15~0,5	180~300	150~250	100~200

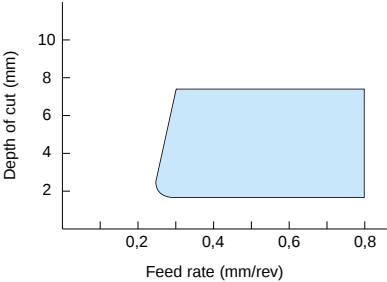


AE Breaker	ITEM CODE (DESIGNATION)		GM8015	GM8020	GM25	CZ25	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)					
	CNMG 120404-AE	CNMG 431-AE	☐	☒	☐	☐	
	120408-AE	432-AE	☐	☒	☐	☐	
	120412-AE	433-AE	☐	☒	☐	☐	
	120416-AE	434-AE	☐	☒	☐	☐	
	160608-AE	542-AE	☐	☒	☐	☐	
	160612-AE	543-AE	☐	☒	☐	☐	
	160616-AE	544-AE	☐	☒	☐	☐	
	DNMG 150604-AE	DNMG 441-AE	☐	☒	☐	☐	
	150608-AE	442-AE	☐	☒	☐	☐	
	150612-AE	443-AE	☐	☒	☐	☐	
	SNMG 120404-AE	SNMG 431-AE	☐	☒	☐	☐	
	120408-AE	432-AE	☐	☒	☐	☐	
	120412-AE	433-AE	☐	☒	☐	☐	
			☐	☒	☐	☐	
	TNMG 160404-AE	TNMG 331-AE	☐	☒	☐	☐	
	160408-AE	332-AE	☐	☒	☐	☐	
	160412-AE	333-AE	☐	☒	☐	☐	
	220404-AE	431-AE	☐	☒	☐	☐	
	220408-AE	432-AE	☐	☒	☐	☐	
	220412-AE	433-AE	☐	☒	☐	☐	
	WNMG 080404-AE	WNMG 431-AE	☐	☒	☐	☐	
	080408-AE	432-AE	☐	☒	☐	☐	
	080412-AE	433-AE	☐	☒	☐	☐	
			☐	☒	☐	☐	



Selection 4. R

RECOMMENDED BREAKER **RE Type** ROUGHING ON STEEL



RECOMMENDED GRADE **GM8020**



CONTINUOUS



GENERAL



INTERRUPTED

RE

RE
GM8015

RE
GM8020

RE
GM25

High Speed/Wear resistance **Toughness/Low Speed**

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)		
		GM8015	GM8020	GM25
2,0~7,0	0,25~0,8	180~300	150~250	100~200

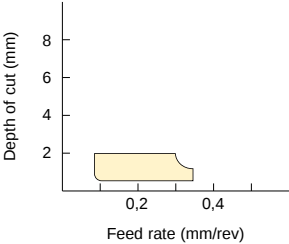


RE Breaker	ITEM CODE (DESIGNATION)		GM8015	GM8020	GM25		CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)					
	CNMG 120408-RE	CNMG 432-RE	☐	☒	☐		
	120412-RE	433-RE	☐	☒	☐		
	120416-RE	434-RE	☐	☒	☐		
	160608-RE	542-RE		☒	☐		
	160612-RE	543-RE	☐	☐	☐		
	160616-RE	544-RE	☐	☐	☐		
	190612-RE	643-RE	☐	☒	☐		
	190616-RE	644-RE	☐	☒	☐		
	DNMG 150608-RE	DNMG 442-RE	☐	☒	☐		
	150612-RE	443-RE	☐	☒	☐		
	150616-RE	444-RE		☒	☐		
				☐			
	SNMG 120408-RE	SNMG 432-RE	☐	☒	☐		
	120412-RE	433-RE	☐	☒	☐		
				☐			
				☐			
	TNMG 160408-RE	TNMG 332-RE	☐	☒	☐		
	160412-RE	333-RE	☐	☒	☐		
	220408-RE	432-RE	☐	☒	☐		
	220412-RE	433-RE	☐	☒	☐		
	220416-RE	434-RE	☐	☐	☐		
	WNMG 080408-RE	WNMG 432-RE	☐	☒	☐		
	080412-RE	433-RE	☐	☒	☐		
				☐			
				☐			



Selection 1. F

RECOMMENDED BREAKER **JE Type** FINISHING ON STAINLESS STEEL



RECOMMENDED GRADE **GM25**



CONTINUOUS



GENERAL



INTERRUPTED



RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)	
		CZ25	GM25
0,5~2,0	0,1~0,3	80~150	100~200

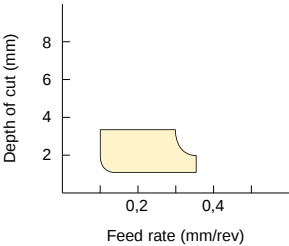


JE Breaker	ITEM CODE (DESIGNATION)					CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)	CZ25	GM25		
	CCMT 060202-JE					
	060204-JE					
	09T302-JE					
	09T304-JE					
	09T308-JE					
	DCMT 070204-JE					
	070208-JE					
	11T302-JE					
	11T304-JE					
	11T308-JE					
	SCMT 09T304-JE					
	09T308-JE					
	TCMT 090202-JE					
	090204-JE					
	110202-JE					
	110204-JE					
	110208-JE					
	16T304-JE					
	16T308-JE					
	TPMR 110308-JE					
	160304-JE					
	160308-JE					
	VBMT 110304-JE					
	110308-JE					
	160404-JE					
	160408-JE					
	VCMT 160404-JE					
	160408-JE					



Selection 2. F

RECOMMENDED BREAKER SE Type FINISHING ON STAINLESS STEEL



RECOMMENDED GRADE GM25



CONTINUOUS



GENERAL



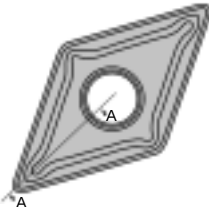
INTERRUPTED



RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)
		GM25
1,0~3,0	0,1~0,35	100~250

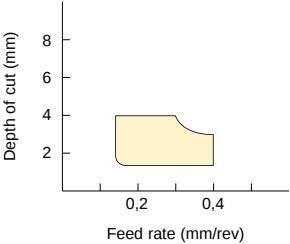


SE Breaker	ITEM CODE (DESIGNATION)		 GM25	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)		
	CNMG 120404-SE	CNMG 431-SE	●	 
	120408-SE	432-SE	●	
	120412-SE	433-SE	●	
	DNMG 150604-SE	DNMG 441-SE	●	
	150608-SE	442-SE	●	
	150612-SE	443-SE	●	
	SNMG 120404-SE	SNMG 431-SE	●	
	120408-SE	432-SE	●	
	TNMG 160404-SE	TNMG 331-SE	●	
	160408-SE	332-SE	●	
	160412-SE	333-SE	●	
	WNMG 080404-SE	WNMG 431-SE	●	
	080408-SE	432-SE	●	
	080412-SE	433-SE	●	



Selection 3. M

RECOMMENDED BREAKER **DE Type** MEDIUM CUTTING ON STAINLESS STEEL



RECOMMENDED GRADE **GX30**



CONTINUOUS



GENERAL



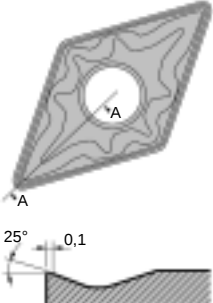
INTERRUPTED



RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)
		GX30
1,0~4,0	0,15~0,4	80~200

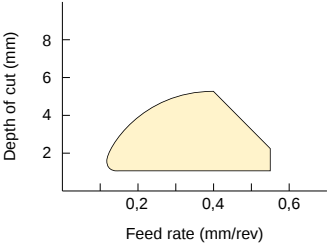


DE Breaker	ITEM CODE (DESIGNATION)		 6X30	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)		
	CNMG 120408-DE	CNMG 432-DE	●	
	120412-DE	433-DE	●	
	DNMG 150608-DE	DNMG 442-DE	●	
	TNMG 160408-DE	TNMG 332-DE	●	
	WNMG 080408-DE	WNMG 432-DE	●	
	080412-DE	433-DE	●	



Selection 4. R

RECOMMENDED BREAKER AE Type ROUGHING ON STAINLESS STEEL



RECOMMENDED GRADE GX30



CONTINUOUS



GENERAL



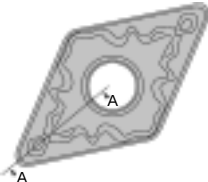
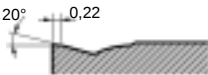
INTERRUPTED



RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)
		GX30
1,0~5,0	0,15~0,5	80~150



AE Breaker	ITEM CODE (DESIGNATION)		  	6EX9		CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)				
	CNMG 120404-AE	CNMG 431-AE	●			 
	120408-AE	432-AE	●			
	120412-AE	433-AE	●			
	120416-AE	434-AE				
	160608-AE	542-AE				
	160612-AE	543-AE				
	160616-AE	544-AE				
	DNMG 150604-AE	DNMG 441-AE	●			
	150608-AE	442-AE	●			
	150612-AE	443-AE	●			
	SNMG 120404-AE	SNMG 431-AE	●			
	120408-AE	432-AE	●			
	120412-AE	433-AE	●			
	TNMG 160404-AE	TNMG 331-AE	●			
	160408-AE	332-AE	●			
	160412-AE	333-AE	●			
	220404-AE	431-AE	●			
	220408-AE	432-AE	●			
	220412-AE	433-AE				
	WNMG 080404-AE	WNMG 431-AE	●			
	080408-AE	432-AE	●			
	080412-AE	433-AE	●			

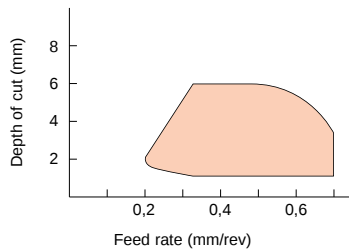
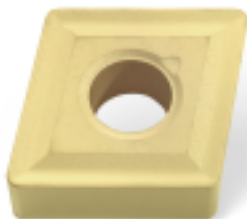


Selection 1. **F**

RECOMMENDED BREAKER

V Type

FINISHING ON CAST IRON



RECOMMENDED GRADE

GM3005



CONTINUOUS



GENERAL



INTERRUPTED

V



GM3005

V



GM3005

non



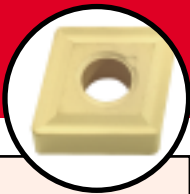
GM3005

High Speed/Wear resistance

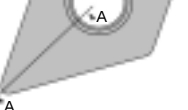
Toughness/Low Speed

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)
		GM3005
0,3~1,0	0,1~0,25	180~300



V Breaker	ITEM CODE (DESIGNATION)		○ ● ⊕ GM3005			CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)				
	CNMG 120404-V	CNMG 431-V				
	120408-V	432-V	●			
	120412-V	433-V	●			
	120416-V	434-V	●			
	160608-V	542-V				
	160612-V	543-V	●			
	160616-V	544-V	●			
	DNMG 150608-V	DNMG 442-V	●			
	150612-V	443-V	●			
	SNMG 120408-V	SNMG 432-V	●			
	120412-V	433-V	●			
	TNMG 160404-V	TNMG 331-V				
	160408-V	332-V	●			
	160412-V	333-V	●			
	160416-V	334-V	●			
	220408-V	432-V	●			
	220412-V	433-V	●			
	VNMG 160404-V	VNMG 331-V	●			
	160408-V	332-V	●			
	160412-V	333-V	●			
	WNMG 080404-V	WNMG 431-V	●			
	080408-V	432-V	●			
	080412-V	433-V	●			

 non Breaker	ITEM CODE (DESIGNATION)				 GM3005		CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)					
	CNMA 120404	CNMA 431			●		
	120408	432			●		
	120412	433			●		
	DNMA 150608	DNMA 442			●		
	150612	443			●		
	SNMA 120408	SNMA 432			●		
	120412	433			●		
	TNMA 160404	TNMA 331			●		
	160408	332			●		
	160412	333			●		
	220408	432			●		
	220412	433			●		
	VNMA 160404	VNMA 331			●		
	160408	332			●		
	WNMA 080404	WNMA 431			●		
	080408	432			●		
	080412	433			●		



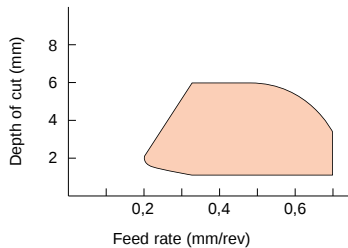
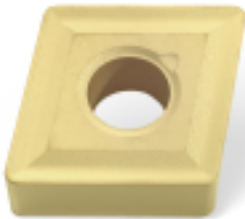


Selection 2. M

RECOMMENDED BREAKER

V Type

MEDIUM CUTTING ON
CAST IRON



RECOMMENDED GRADE

GM8015



CONTINUOUS



GENERAL



INTERRUPTED

V



GM3005

V



GM8015

non



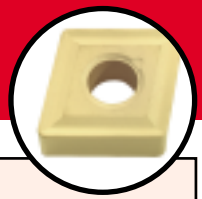
GM8015

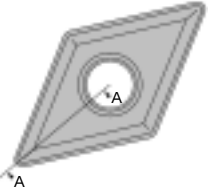
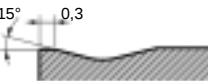
High Speed/Wear resistance

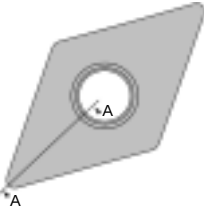
Toughness/Low Speed

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)	
		GM3005	GM8015
1,0~5,0	0,15~0,4	180~300	150~250



 Breaker	ITEM CODE (DESIGNATION)		 GM3005	 GM8015		CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)				
	CNMG 120404-V	CNMG 431-V		●		 
	120408-V	432-V	○	●		
	120412-V	433-V	○	●		
	120416-V	434-V	○	●		
	160608-V	542-V		●		
	160612-V	543-V	○	●		
	160616-V	544-V	○	●		
	DNMG 150608-V	DNMG 442-V	○	●		
	150612-V	443-V	○	●		
	SNMG 120408-V	SNMG 432-V	○	●		
	120412-V	433-V	○	●		
	TNMG 160404-V	TNMG 331-V		●		
	160408-V	332-V	○	●		
	160412-V	333-V	○	●		
	160416-V	334-V	○	●		
	220408-V	432-V	○	●		
	220412-V	433-V	○	●		
	VNMG 160404-V	VNMG 331-V	○			
	160408-V	332-V	○	●		
	160412-V	333-V	○	●		
	WNMG 080404-V	WNMG 431-V	○	●		
	080408-V	432-V	○	●		
	080412-V	433-V	○	●		

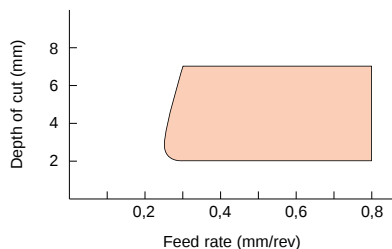
non Breaker	ITEM CODE (DESIGNATION)				 GM8015	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)				
	CNMA 120404	CNMA 431			●	
	120408	432			●	
	120412	433			●	
	DNMA 150608	DNMA 442			●	
	150612	443			●	
	SNMA 120408	SNMA 432			●	
	120412	433			●	
	TNMA 160404	TNMA 331			●	
	160408	332			●	
	160412	333			●	
	220408	432			●	
	220412	433			●	
	VNMA 160404	VNMA 331			●	
	160408	332			●	
	WNMA 080404	WNMA 431			●	
	080408	432			●	
	080412	433			●	





Selection 3. R

RECOMMENDED BREAKER **RE** Type ROUGHING ON CAST IRON



RECOMMENDED GRADE **GM8015**



CONTINUOUS



GENERAL



INTERRUPTED

V



GM3005

RE



GM8015

non



GM8015

High Speed/Wear resistance

Toughness/Low Speed

RECOMMENDED CUTTING CONDITIONS

DEPTH OF CUT (MM)	FEED RATE (MM/REV)	CUTTING SPEED (M/MIN)	
		GM3005	GM8015
2,0~7,0	0,3~0,8	150~250	100~250



RE

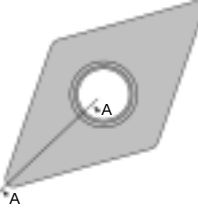
Breaker

	ITEM CODE (DESIGNATION)	
	ITEM CODE (METRIC)	ITEM CODE (INCH)

CHIP BREAKER
SHAPE

	CNMG 120404-V	CNMG 431-V				
	120408-V	432-V	●			
	120412-V	433-V	●			
	120416-V	434-V	●			
	160608-V	542-V				
	160612-V	543-V	●			
	160616-V	544-V	●			
	DNMG 150608-V	DNMG 442-V	●			
	150612-V	443-V	●			
	SNMG 120408-V	SNMG 432-V	●			
	120412-V	433-V	●			
	TNMG 160404-V	TNMG 331-V				
	160408-V	332-V	●			
	160412-V	333-V	●			
	160416-V	334-V	●			
	220408-V	432-V	●			
	220412-V	433-V	●			
	VNMG 160404-V	VNMG 331-V	●			
	160408-V	332-V	●			
	160412-V	333-V	●			
	WNMG 080404-V	WNMG 431-V	●			
	080408-V	432-V	●			
	080412-V	433-V	●			



non Breaker	ITEM CODE (DESIGNATION)				 GM8015	CHIP BREAKER SHAPE
	ITEM CODE (METRIC)	ITEM CODE (INCH)				
	CNMA 120404	CNMA 431			●	
	120408	432			●	
	120412	433			●	
	DNMA 150608	DNMA 442			●	
	150612	443			●	
	SNMA 120408	SNMA 432			●	
	120412	433			●	
	TNMA 160404	TNMA 331			●	
	160408	332			●	
	160412	333			●	
	220408	432			●	
	220412	433			●	
	VNMA 160404	VNMA 331			●	
	160408	332			●	
	WNMA 080404	WNMA 431			●	
	080408	432			●	
	080412	433			●	

Calculation for turning

- Cutting speed : $V(\text{m/min}) V = \frac{\pi \times D \times N}{1000}$
- Revolution : $N(\text{min}^{-1}) N = \frac{1000 \times V}{\pi \times D}$
- Feed per revolution : $f(\text{mm/rev}) f = \frac{L}{N}$
- Operation time : $T(\text{min}) T = \frac{L}{f \times N}$
- Chip removal time : $Q(\text{m}^3/\text{min}) Q = \frac{\pi \times d \times (D-d) \times N \times f}{1000}$
- Cutting power : $Ne(\text{kw}) Ne = \frac{d \times f \times V \times Ks}{60.000 \times \eta}$

Ks valve

Material	Feed and cutting force per area
	$f = 0,1 \sim 0,4$
Carbon steel	3000 ~ 2500
Alloy steel	4500 ~ 3000
Cast iron	2000 ~ 1500

Ks : Cutting force per area (N/mm^2)

η : modulus of machine efficiency

0,8 ~ 0,7

High rigidity

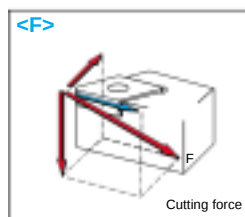
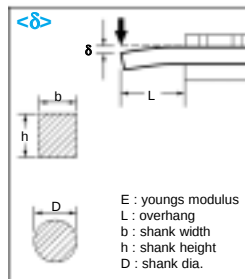
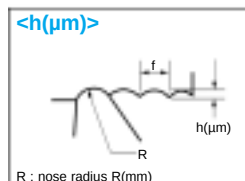
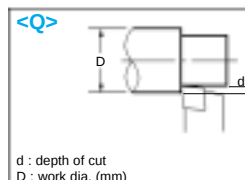
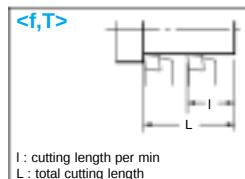
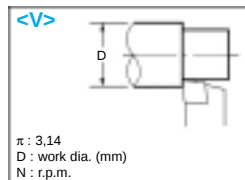
New machine Old machine

- Theoretical surface roughness : $h(\mu\text{m}) h = \frac{f^2}{8 \times R} \times 1000$

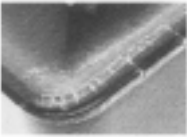
- Deflection : $\delta(\text{mm}) \delta = \frac{4 \times f \times d \times Ks \times L^3}{E \times b \times h^3}$
(Toolholder in square)

- Deflection : $\delta(\text{mm}) \delta = \frac{64 \times f \times d \times Ks \times L^3}{3 \times \pi \times E \times D^4}$
(Toolholder in round)

- Cutting force : $F(\text{N}) F = d \times f \times Ks$



Tool failure and trouble shooting in turning

Failure Conditions	Cause	Trouble shooting		
		Grade	Tool geometry	Cutting conditions
Seriously worn relief surface 	● Cutting speed to high ● Abrasion resistance of tool not sufficient.	● Use material of higher abrasion resistance. ● GM25 → GM8015 → GM3005 ● For normal abrasion, use a coated cermet.	● Use material of higher crater abrasion. ● GM25 → GM8015 → GM3005	● Reduce cutting speed. ● Adopt wet cutting method.
Seriously worn rake 	● Cutting speed to high ● Feed rate to high	● Use material of higher crater abrasion. ● GM25 → GM8015 → GM3005	* Review chip breaker quality. (Use a breaker of less breaking effect.)	● Reduce cutting speed. ● Reduce feed rate. ● Adopt wet cutting method.
Deformation 	● Cutting edge was softened by high speed cutting at high feed rate.	● Use material of higher heat resistance. ● GM3005 → GM8015 → GM25	● Change the shape to a larger corner radius. * Review chip breaker quality. (Use a breaker of less breaking effect.)	● Reduce cutting speed. ● Reduce feed rate. ● Adopt wet cutting method.
Thermal crack 	● Thermal stress, thermal fatigue	● Use material of heat and shock resistance. ● GM3005 → GM8015 → GM25 ● CZ25	* Review chip breaker quality. (Use a breaker of less breaking effect.)	● Reduce cutting speed. ● Reduce feed rate. ● Adopt wet cutting method.
Chipping 	● Vibration, shock.	● Use tougher material. ● GM3005 → GM8015 → GM25 ● CZ25	● Review chip breaker quality. (Use a breaker of higher cutting edge strength.) ● Use tougher holder. ● Reduce holder protrusion.	● Reduce feed rate. ● Cut at smaller cutting amount.
Initial chipping 	● Mechanical strength of tool not sufficient. ● Unsuitable cutting conditions.	● Use tougher material. ● GM3005 → GM8015 → GM25 ● CZ25	● Review chip breaker quality. (Use a breaker of higher cutting edge strength.) ● Use tougher holder. ● Reduce holder protrusion.	● Reduce feed rate. ● Cut at smaller cutting amount.

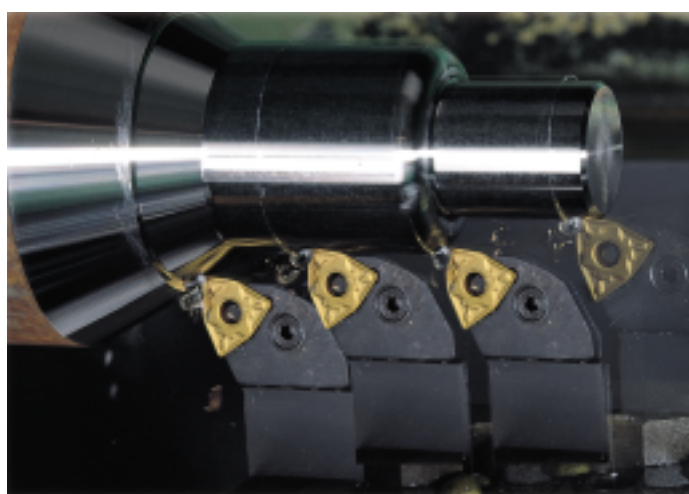
Material table on each country

ISO	Japan	Gemyany		USA	UK	Sweden	France	Italy
	JIS	W.-nr.	DIN	AISI/SAE	BS	SS	AFNOR	UNI
	S10C	1.1121	Ck10	1010	045M10	1265		C10
	S15C	1.1141	C16	1015	080M15	1370	XC12	C16
	S25C	1.1158	Ck25	1025	050 A 20	1450		
	S35C	1.1183	Cf35	1035	060A35	1572	XC38TS	C36
	S45C	1.1191	Ck45	1045	080M46	1672	XC42	C45
	S50C	1.1213	Cf53	1050	060A52	1674	XC48TS	C53
	S55C	1.1203	Ck55	1055	070M55		XC55	C50
	S58C	1.1221	Ck60	1060	080A65	1678	XC60	C60
	SB410	1.0425	Hll			1432		
	SC450	1.0433	GS-45	A27 65-35	A1	1305		
	SCM415	1.7262	15CrMo5			2216	12CD4	
	SCM420;SCM430	1.7218	25CrMo4	4130	1717CDS110	2225	25CD4	25CrMo4
	SCM432;SCCRM3	1.7220	34CrMo4	4137	708A37	2344	35CD4	35CrMo4
	SCM440	1.7223	41CrMo4	4140	708M40	2244	42CD4TS	41CrMo4
	SCM440(H)	1.7225	42CrMo4	4140	708M40	2244	42CD4	42CrMo4
	SCMn1	1.1170	28Mn6	1330	150M28		20M5	C28Mn
	SCr415(H)	1.7015	15Cr3	5015	523M15		12C3	
	SCr430(H)	1.7033	34Cr4	5132	530A32		32C4	34Cr4
	SCr440	1.7045	42Cr4	5140		2245		
	SCr440(H)	1.7035	41Cr4	5140	530M40		42C4	41Cr14
	SK3	1.1545	C105W1	W1	BW1A	1880	Y105	C36KU
	SKS2;SKS3							107WCr5KU
	SKS31	1.2419	105WCr6			2140	105WC13	10WCr6
	SMn420	1.1133	GS-20Mn5	102	120M19	1410		G22Mn3
	SMn438(H)	1.1167	36Mn5	1335		2120	40M5	
	SNC236	1.5710	36NiCr6	3135	640A35		35NC6	
	SNC415(H)	1.5732	14NiCr10	3415			14NC11	16NiCr11
	SNC815(H)	1.5752	14NiCr14	3415 3310	655M13		12NC15	
	SNCM220(H)	1.6523	21NiCrMo2	8620	805M20	2506	20NCD2	20NiCrMo2
	SNCM240	1.6546	40NiCrMo22	8740	311-Type7			40NiCrMo2
	SS400	1.0144	St44-3	A573-81	4360 43 C	1412		
	SUJ2	1.3505	100Cr6	52100	534A99	2258	100C6	100Cr6
	SUM22	1.0715	9SMn28	1213	230MO7	1912	S250	CF9SMn28
	SUM22L	1.0718	9SMnPb28	12L13		1914	S250Pb	CF9SMnPb28
	SUP4	1.1545	C105W1	W210	BW2	2900	Y120	C120KU
	SUP9(A)	1.7176	55Cr3	5155	527A60		55C3	
		1.1157	40Mn4	1039	150M36		35M5	
		1.5423	16Mo5	4520	1503-245-420			16Mo5
		1.5680	12Ni19	2515			Z18N5	
		1.6511	36CrNiMo4	9840	816M40		40NCD3	38NiCrMo4
		1.6582	34CrNiMo6	4340	817M40	2541	35NCD6	35NiCrMo6
		1.6587	17CrNiMo6		820A16		18NCD6	
		1.6657	14NiCrMo134		832M13			15NiCrMo13
		1.7131	16MnCr5	5115		2511	16MC5	16MnCr5
		1.7336	13CrMo4	ASTM A182			15CD3.5	14CrMo45
					655A12			

ISO	Japan	Germany		USA	UK	Sweden	France	Italy
	JIS	W.-nr.	DIN	AISI/SAE	BS	SS	AFNOR	UNI
	SCS13	1.4308	G-X6CrNi18.9		304C15		Z6CN18.10M	
	SCS14	1.4408	G-X6CrNiMo		316C16			
	SCS16	1.4435	X2CrNiMo	316L	316S12	2353	Z2CND17.13	X2CrNiMo17.13
	SCS19	1.4306	X2CrNi18.9	304L	304S12	2352	Z2CN18.10	X2CrNi18.11
	SCS5	1.4313	X5CrNi13.4		425C11		Z4CND13.4M	
	SUH309	1.4828	X15CrNiSi	309	309S24		Z15CNS20.12	
	SUH310	1.4845	X12CrNi25.21	310S	310S24	2361	Z12CN25.20	X6CrNi25.2
	SUH330	1.4864	X12NiCrSi	330			Z12NC35.16	
	SUS301	1.4310	X12CrNi17.7	301	301S21	2331	Z12CN17.07	X12CrNi17.07
	SUS303	1.4305	X12CrNiS18.8	303	303S21	2346	Z10CNF18.09	X10CrNiS18.09
	SUS304	1.4301	X5CrNi189	304	304S15	2332	Z6CN18.09	X5CrNi18.10
	SUS304L				304C12	2333	Z3CN19.10	
	SUS304LN	1.4311	X2CrNiN	304LN	304S62	2371	Z2CN18.10	
	SUS316	1.4401	X5CrNiMo	316	316S16	2347	Z6CND17.11	X5CrNiMo17.12
	SUS316L		18.12					
	SUS316LN	1.4429	X2CrNiMoN	316LN		2375	Z2CND17.13	
	SUS317L	1.4438	X2CrNiMo	317L	317S12	2367	Z2CND19.15	X2CrNiMo18.16
	FC100		GG10	ASTM 20B	100			
	FC150	0.6015	GG15	A48-25B	150	0115-00		G15
	FC200	0.6020	GG20	A48-30B	200	0120-00		G20
	FC250	0.6025	GG25	A48-40B	260	0125-00		G25
	FC300	0.6030	GG30	A48-45B	300	0130-00		G30
	FCD400	0.7040	GGG40	60/40/18	400/17	0717-02		GS370-17
	FCD500	0.7050	GGG50	65/45/12	500/7	0717-02		GS500-7
	FCD600	0.7060	GGG60	80/55/06	600/3	0727-03		GS600-2
	FCD700	0.7070	GGG70	100/70/03	700/2	0737-01		GS700-2

Guide to grades for turning inserts

JIS (ISO)			Main Grades		Sub Grades
			Coated Carbide	Coated Cermet	Coated Grades
 Carbon Steels Alloyed Steels (SS,SCM,SCR SC,SNCM...) Tools Steels, HSS Cast Steels	01	Finishing	GM8015		
	10				
	20	General	GM8020	CZ25	GM20
	30				
	40	Roughing	GM25		GX30
 Carbon Steels Alloyed Steels (SUS304) Mn Steels	01	Finishing	GM25		GM20
	10			CZ25	GM8020
	20	General	GX30		
	30				
	40	Roughing			
 Cast Iron (FC250...) Ductile Cast Iron (FCD450...)	01	Finishing	GM3005		
	10				
	20	General	GM8015		
	30	Roughing			



Chip groove table

ISO						
Application						
Manufacturer	Finishing		Medium	Roughing	General	
HITACHI TOOL	 JE		 BE		 SE	 DE [AE]
	 AE		 RE		 V (non)	
Mitsubishi	SQ FV	FH FS SH	MH MA MZ	GH MAT HA	MS ES	MS MA
Toshiba	PS 24	TS 11 17	TM 32Y 37	TH TU 57	SS S	SS S TM
Sumitomo	NFP NSU	NSK NSU NFP	NUG NUX NUA	NMU NMX NMP	NUP	NUP NEX
Kyocera	HQ	DP GP XP	HS GS HK	GT HT	ST	GU HU
Sandvik	UF UM	PF MF QF	PM SM QM	PR MR	MF	MM MR
Kennametal	LF MF	SF UF	SK MF	MG P	MG	MP
Iscar	SM	SF NF	GN	NM	PP	TF
Widia	2 41	4 22	48 5	49	4	4

Grade table

ISO								
Application								
Manufacturer	Finishing	Finishing	Medium	Roughing	Finishing	Medium / Roughing	Finishing	Medium / Roughing
HITACHI TOOL	CZ 25	GM 8015	GM 8020 (GM20)	GM 25	GM 25	GX 30	GM 3005	GM 8015
Mitsubishi	UP35N GP20N	UE6005 UC6010	UC610 UC6010	UC6025 US7020	UC6025 US7020	US735	UC5005 U410	UE6005 UC6010
Toshiba	GT30	T5020 T7010	T715X T7015	T725X T7015	T725X T7015	T335S	T5010	T5020 T7010
Sumitomo	T130Z T12Z	AC1000 AC500G	AC1000 AC2000	AC3000	AC3000	AC304	AC105G AC110G	AC1000 AC500G
Kyocera	PV30 PV90	CR7015	CA115	CR7025 CR600	CR7025 CR600	CA225	CR300	CR7015
Sandvik	GC1525	GC4015	GC4025 GC425	GC4035 GC435	GC4035 GC435	GC2025 GC235	GC3015 GC3020	GC4015
Kennametal	PS5	KC9025	KC9040	KC9045	KC9045	KC935	KC9010	KC9025
Iscar	IC20N	IC635	IC635 IC656	IC8025	IC8025	IC8025	IC428	IC635
Widia	TTI15	TN7010 TN150	TN7015 TN200	HK35 TN200	HK35 TN200	HK35 TN200	HK150	TN7010 TN150