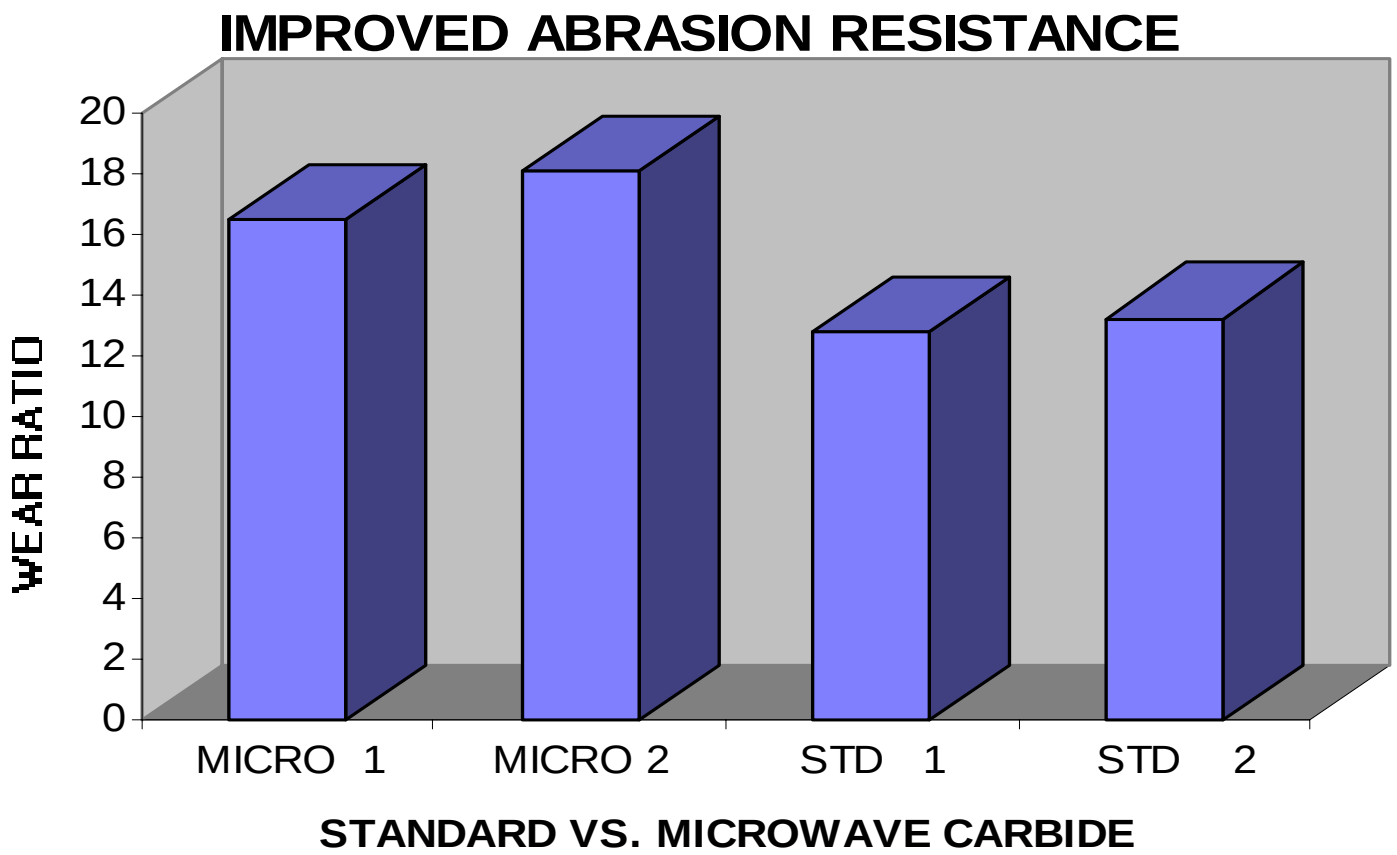
MICROWAVE SINTERING OF WC-Co BASED CEMENTED CARBIDES

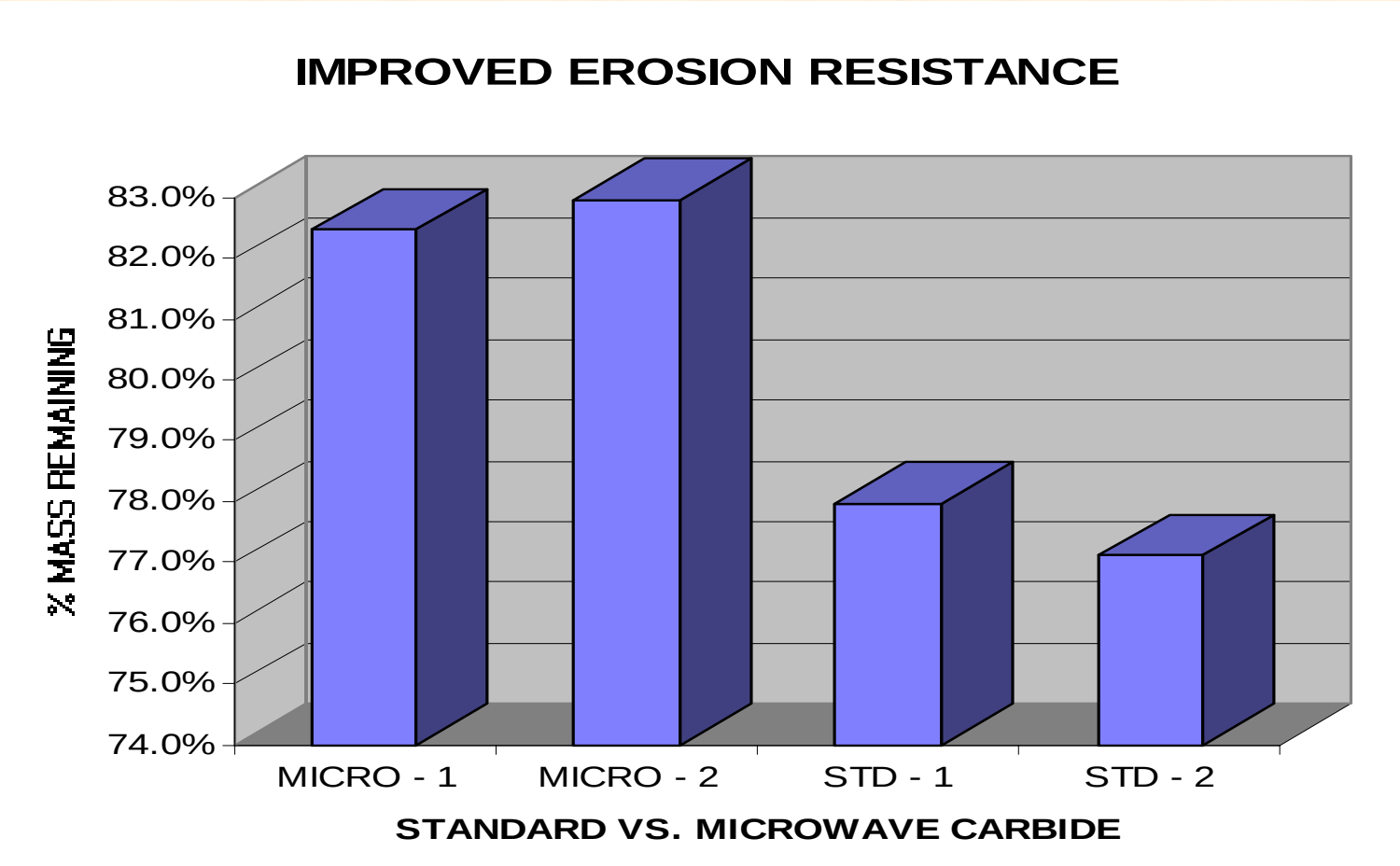
Rockwell A Hardness

Co wt.%	Heating Process	Sintering °C/time	ardness
6	MW	1450/10min.	88.25± 0.67 A
6	Conv.	1450/1hr	81.80± 0.91
12	MW	1300°C/10 min	88.87± 0.10
12	Conv.	1300°C1h	84.84± 0.53
12	MW	1350°C/10 min	87.16± 0.21
12	Conv.	~1440°C/~2h	86.32± 0.41

ABRASION RESISTANCE



EROSION RESISTANCE

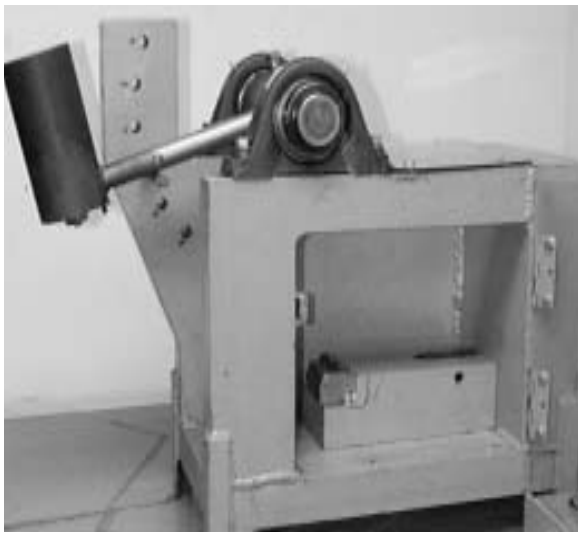


IMPROVED EROSION RESISTANCE

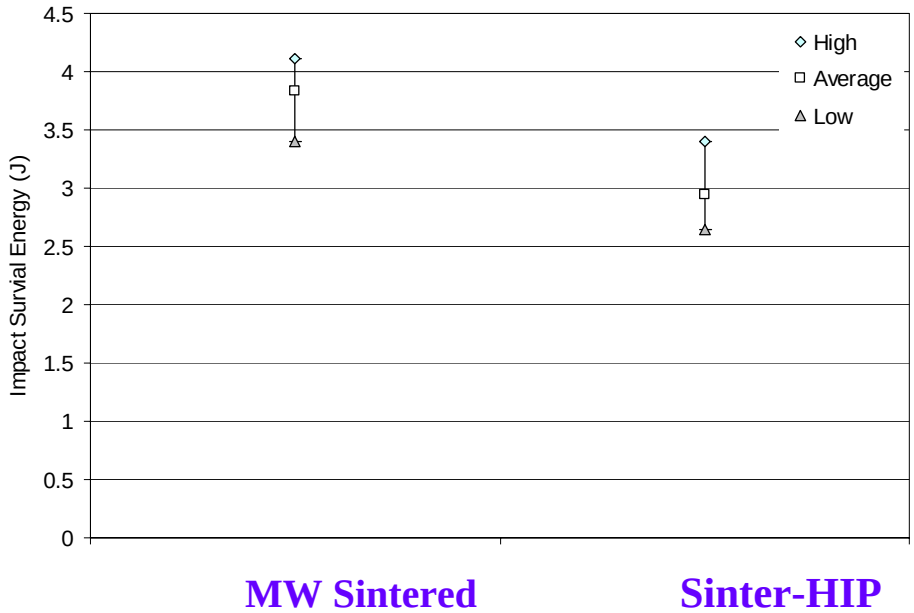
MICROWAVE SINTERED

CONVENTIONALLY SINTERED

Improved Impact Strength



Impact Apparatus



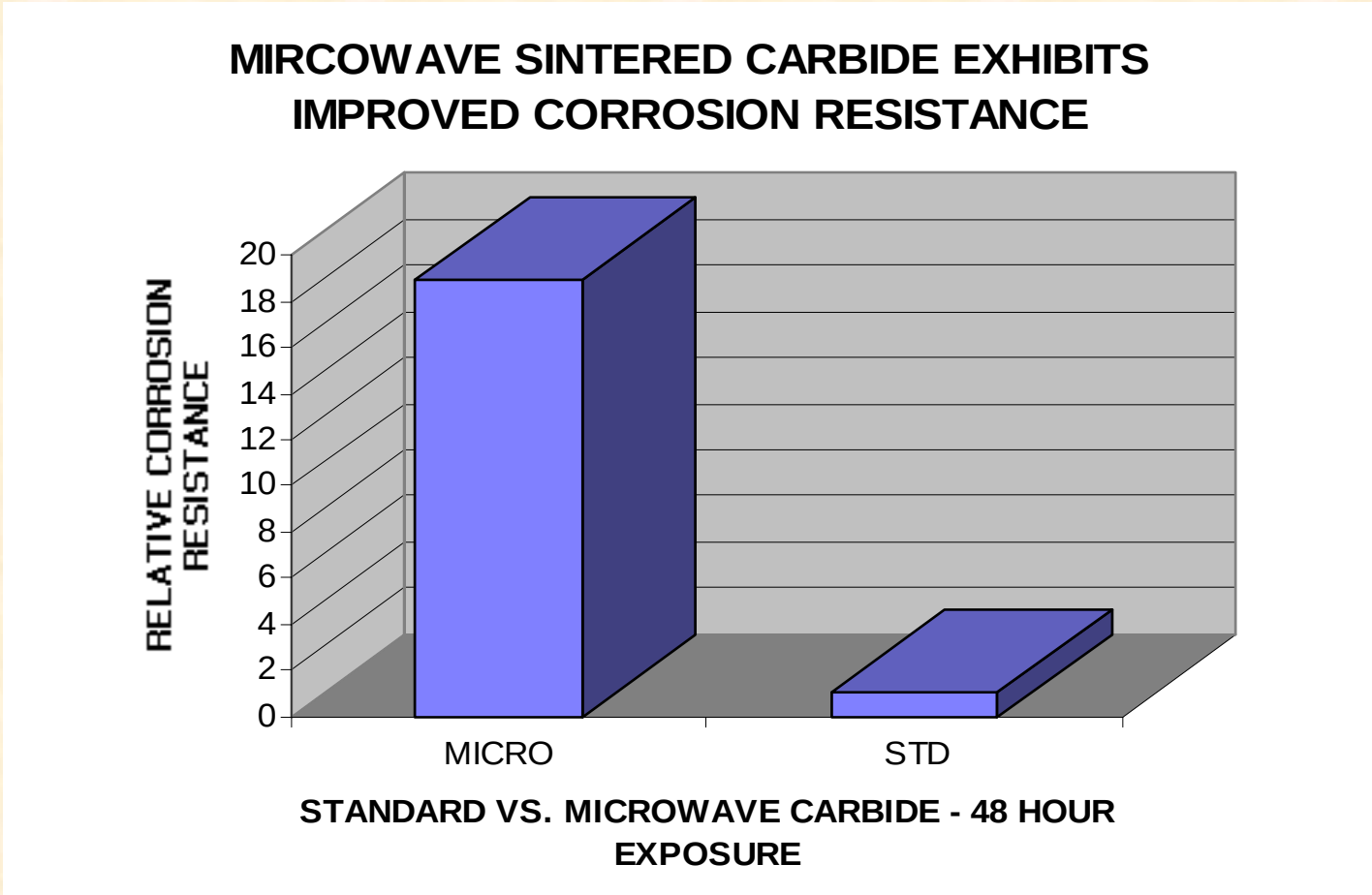
COMPARISON OF CONVENTIONALLY AND MICROWAVE SINTERED WC-Co DRILL PARTS

IMPROVED IMPACT STRENGTH

MICROWAVE SINTERED

CONVENTIONALLY SINTERED

IMPROVED CORROSION RESISTANCE



ROLLING CONE BIT COMPONENTS
PDC, CARBIDE, MICROWAVE SINTERED TSD

MICROWAVE SINTERED TSD COMPOSITE INSERTS

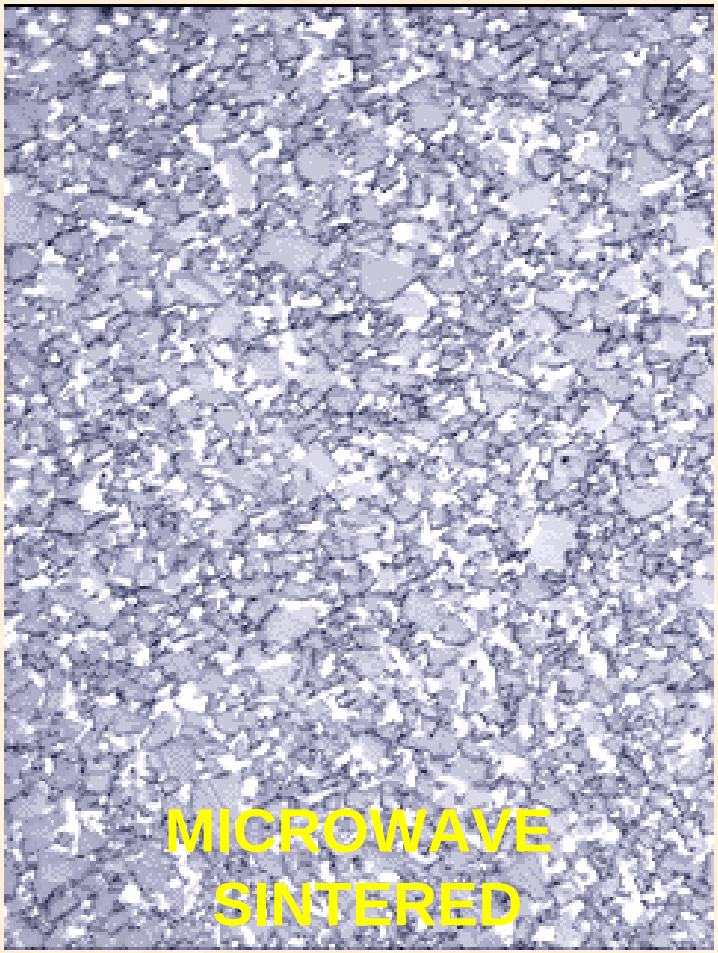
ABRASION RESISTANT TSD MICROWAVE SINTERED IN TUNGSTEN CARBIDE

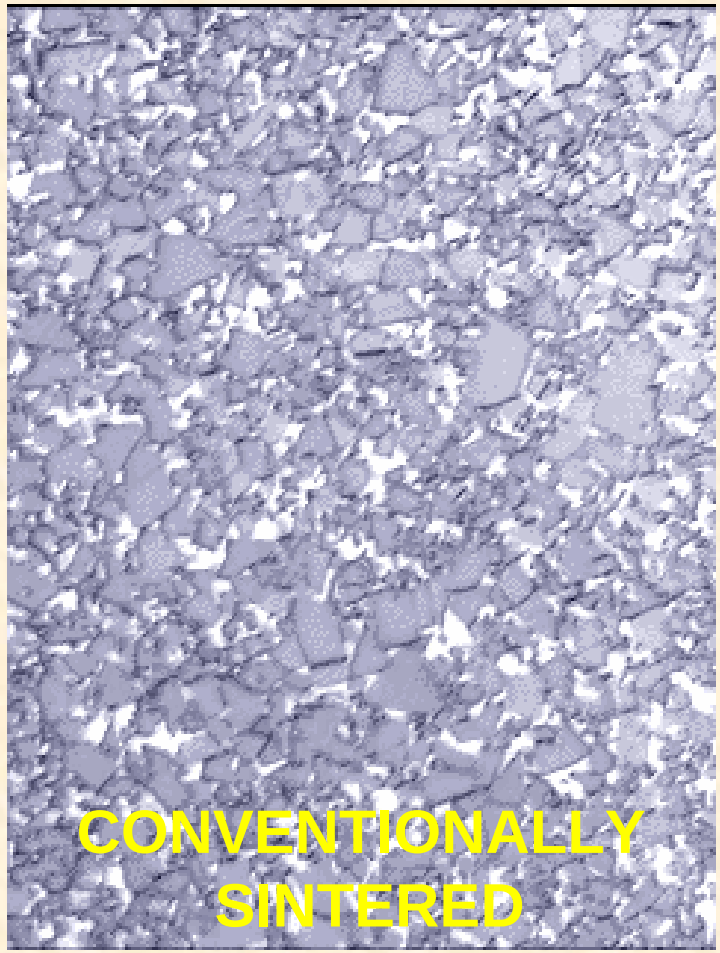
Part 12154
14.4mm DIAM x .12.7mm LONG
3 TSD ELEMENTS 4mm DIAM.

MICROWAVE SINTERED TUNGSTEN CARBIDE IMPROVED PROPERTIES

- Fine grain structure
- No grain growth inhibitors
- Uniform cobalt distribution
- Improved abrasion resistance
- Improved erosion resistance
- Improved corrosion resistance
- Improved impact strength
- More energy efficient process
- Less capital intensive

FROM IDENTICAL GREEN PARTS at 1500X





V1.5 Microwave Sintering Furnace

DENNIS TOOL COMPANY

Dimensions and Weight
36"x 145"x 114"
3500 lbs

Microwave Power & Frequency
6.0 kW at 2.45 GHz

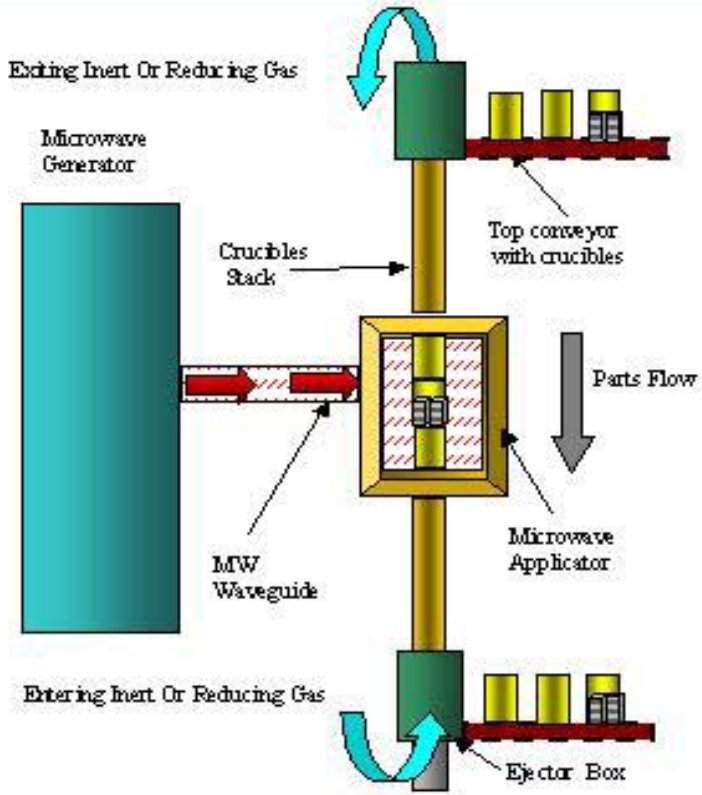
Cooling Requirements
Water at 70° +/- 10° F at 50 psig
MW Generator 1.5 gpm
MW Applicator 1.5 gpm

Electrical Requirements
MW Generator
120 vac/3 phase at 50/60 Hz circuit 20 A
Hydraulic drive
230/460 vac/3 phase at 60 Hz circuit 15 A
Applicator
120 vac/1phase at 60 Hz circuit 30 A

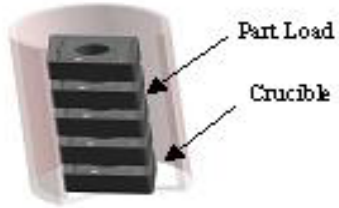
Maximum operating temperature
1500° C (2732° F)

Atmosphere Multi-mode
Inert or Reducing gas

Crucible Size – Volume 1.50 cu. inch
1.10" OD / 0.98"ID
2" Height



V1.5 Microwave Furnace Capacity Chart



Part Description	Part Sintered Dimensions	Parts per Layer	No. of Layers	Parts per crucible	Parts per 24 hr.[1]	Carbide Parts
Cutting Tool Inserts						
CNMG 322	0.375" x 0.125"	1	6	6	1555	
CNMG 434	0.500" x 0.187"	1	5	5	1296	
DCMG 442	0.500" x 0.250"	1	1	1	288	
DCMG 542	0.625" x 0.250"	1	1	1	288	
SNMG 322	0.375" x 0.125"	1	6	6	1555	
SNMG 432	0.375" x 0.187"	1	5	5	1296	
TNMG 221	0.250" x 0.125"	2	6	12	3110	
TNMG 321	0.375" x 0.125"	1	4	4	1036	
Rolling Cone Drill Bit Inserts						
Gage cylinders	0.375" x 0.250"	2	4	8	2073	
Gage cylinders	0.500" x 0.375"	1	3	3	777	
Cutting domes	0.375" x 0.250"	2	4	8	2073	
rounds, chisels	0.500" x 0.375"	1	3	3	777	
PDC Substrates						
13 mm rounds	0.540" x 0.315"	1	3	3	777	
19 mm rounds	0.780" x 0.315"	1	3	3	777	
Wire Die Nibs						
R-4 Nib	0.500" x 0.450"	1	2	2	518	
R-8 Nib	1.000" x 0.820"	0	1	0	0	
Mining Bits Inserts						
1" Roof-bolt	1.025" x 0.185" x 0.525"	2	1	2	518	
1-3/8" Roof-bolt	1.400" x 0.185" x 0.675"	1	1	1	259	
1-1/2" Roof-bolt	1.525" x 0.185" x 0.775"	0	1	0	0	

[1] The furnace capacity chart is intended as guide line. Crucible capacity is based upon a nominal 20% dimensional shrinkage. Furnace throughput is based upon a 5 minute sintering cycle for a 24-hour period at 90% efficiency. Actual part per crucible loading and furnace throughput may vary from the stated values above.