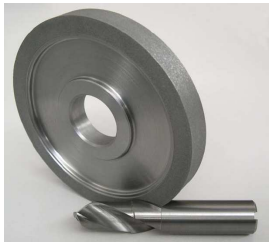

CAFRO manufactures a complete range of Diamond & CBN wheels.
Recently an extensive test program has been carried out for optimising the grinding conditions for fluting operations of solid carbide drills and end mills on CN machines working with neat oil and hybrid bond Diamond wheels of the last generation.
The recommended CAFRO hybrid bond is M 405: exceptionally good performances has been reached using low rotating speeds (***Vc 12 m/sec***)

Example :

- Solid carbide end mill Z 3 Ø 20 mm – 20° flute incl. – flute length 102 mm
- Machine : Walter Helitr. Power – coolant neat oil at 11 bars – fine filtering system
- Depth of cut 5,6 mm – removal per tool 230 grams (Q'w = 5,0 mm^3/mm/sec)
- Results with different cutting speeds (Vc) :

  A) 16 m/sec = carbide warmup, smoke, cutting power decreasing piece to piece

  B) 12 m/sec = cool grinding, lower coolant press. (7 bar), good profile retention.
- Wheel corner holding ability : due to reduced loading forces, the Diamond holding ability of the bond is improved, resulting in a better wheel profile retention.

Features playing in favour of lower wheel rotation speed (Vc = 12 m/sec)

1. Higher Diamond wheel cutting power with no losses in corner retention ability.
2. Less vibrations and out of balance during the feed.
3. Less heat development (carbide and wheel remain cool till the feed end).
4. Reduced fire risks due to smoke development along the feed, mostly during unmanned shifts.
5. Possibility of using finer grit sizes, thus allowing better finishing at no extra costs.
6. Reduced danger of carbide cracks due to overloading stresses during fluting.
7. Possibility of reducing the coolant pressure, lowering the coolant nebulization and oil fog aspiration, thus less oil consumption and less special waste disposal.
8. Enabling lower induced stresses and spindle wear, thus longer spindle life (could be till + 20 ÷ 30%) and lower machine maintenance costs

Features playing against lower wheel rotation speed (Vc = 12 m/sec)

9. On old generation machines (manufactured over 10 years ago) the brushless motors weren't employed, thus reducing the rotation speed means torque reduction as well, and the motor power could result insufficient; this is especially true with mayor wheel diameters (e.g. 125 ÷ 150 mm Ø).

The following examples were conceived as a comparison between different speeds, where the machine and the wheel have been the same

[wheel specs : ***D 64 SQ 125 M405*** *].*

It has been found that the low speed brought significant benefits: the profile holding ability and the wheel wear have not been reduced; on the other hand the material removal ability in the fluting operation showed the so far better achieved results.

Example A

Workpiece	solid carbide endmill Z 4 - Ø 20 mm – flute lenght 70 mm	
Depth of pass	4,5	mm (single hub)
Feed	80	mm / min
Batch	30	workpieces

Notes :

A) at Vc = 16 m/sec :
strong heat generation – some flute microcracks during the night shift

B) at Vc = 12 m/sec :
no microcracks on the lot (30 pcs) – wheel wear 0,05 mm in Radius after 30 pcs.

Example B

Workpiece	solid carbide endmill Z 4 - Ø 20 mm – flute lenght 70 mm	
Depth of pass	4,5	mm (single hub)
Fluting time	7	min [removal 1.200 mm^3/min]
Batch	15	workpieces

Notes :

A) at Vc = 16 m/sec :
noisy – rising power consumption – more frequent dressing need

B) at Vc = 12 m/sec :
stable power consumption – no dressing need – wheel wear 0,04 mm on radius

Example C

Workpiece	solid carbide endmill Z 3 - Ø 20 mm – flute lenght 72 mm – 20° R-thread	
Flute depth	5,0	mm (single hub)
Feed	75	mm / min
Batch	20	workpieces

Notes :

A) at Vc = 16 m/sec :
Vibrations – insufficient free cutting power

B) at Vc = 12 m/sec :
no vibrations - free cutting – was the best wheel ever tested

Example D

Workpiece	solid cardide endmill Z 3 - Ø 20 mm – flute lenght 102 mm – 20° R-thread	
Flute depth	5,6	mm (single hub) – total removal 230 gr !
Feed	60	mm / min
Batch	30	workpieces

Notes :

A) at Vc = 16 m/sec :
heat generation and oil mist – increasing power consumption from the second piece

B) at Vc = 12 m/sec :
Wheel and workpiece keep cool even with 6 bar oil pressure only
Finishing passes with increased speed of 25 m/sec