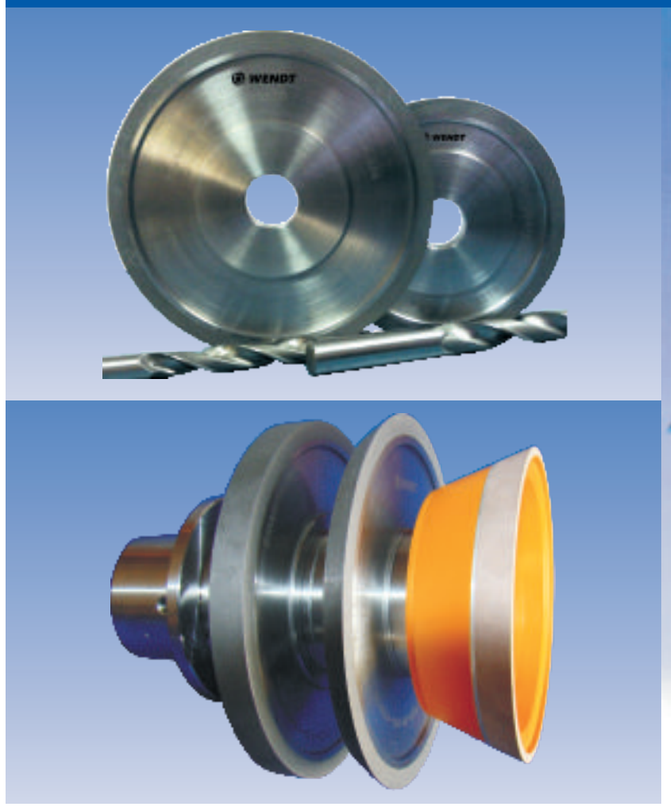
HYBRID Wheels



Grinding redefined

Technical Guidance Manual

WENDT

Hybrid Wheels

The New Generation Grinding Wheels

The trend in Carbide Drill / Endmill manufacturers is clearly towards high productivity and consistent quality. This has put great demands on the Diamond wheel manufacturers to come up with wheels which can grind faster, put less strain on the machine and Job that is being ground.

WENDT offers a perfectly matched range of products that allow you to take full advantage of the CNC machine to manufacture your cutting tools. These wheels are made of a new generation HYBRID bond.

Hybrid Wheels ensure higher material removal without compromising on the surface finish, while ensuring considerable reduction in cycle times. These wheels can be used for both Fresh tool manufacturing and re-sharpening, on CNC Tool and Cutter Grinders.

The unique properties of the Hybrid Wheels

- Capable of taking higher depth of cuts.
- High lubrication at the point of grinding
- Lesser load on the spindle motor
- Increased profile retention of the wheel
- Lower grinding force on the work piece, which results in lesser work piece deflection during Grinding

These properties of the Hybrid bond improve the performance of the CNC Tool and Cutter Grinder in the following ways.

- Increased rate of material removal with high temperature stability
- Reduced grinding time per component
- Low and constant power consumption
- High profile stability and better machine productivity
- Long wheel life and long dressing interval

Bond Systems

	RESIN	METAL	VITRIFIED	HYBRID
Material Removal Rate	→	→	↑	↑
Freeness to Cut	→	↓	↑	↗
Form Holding Capability	→	↑	→	↑
Ease of Trueing (with Al_2O_3 Wheel)	↑	→	↑	↑

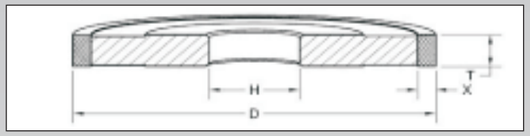
HYBRID Wheels
Grinding Redefined

Flute Grinding

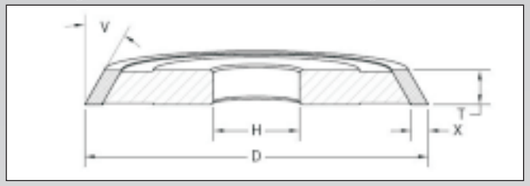
Flute Grinding involves high stock removal – almost 2 to 6mm cutting depth. It is not only a time consuming operation, but highly demanding one too. The contact area in fluting is large and it is difficult for the coolant to reach the zone of grinding effectively. To minimize the risk of excessive heat generation, quite often the machine users reduce the depth of cut or the feed rate. Wendt Hybrid Wheels address this problem very effectively.

Wendt Hybrid Fluting Wheels are available in 1A1 and 1V1 R type execution.

Ordering Example.: B10A.ISP. 003 - 20H7 Bore



Ordering Example.: B15A.ISP.012 – Angle 12° - 31.75H7 Bore



Recommended Peripheral Speed and Feed Rates for Hybrid Fluting Wheels

Normally machine users tend to grind at very high peripheral speeds. This often results in heavier spindle load which in turn leads to lowering of feed rates, frequent truing and sharpening/exposing of the wheel. Which means more time to do the job and additional cost !

To avoid this, we recommend:
Maintain Vc at 16 – 22 m/sec
To achieve Qw' of 4 – 9 mm^3/mm/sec,

$$V_t = \frac{Q'_w \times 60}{a_e}$$

Spindle kW	Q'_w Range
9	4 to 5
11 to 16	5 to 7
16 to 35	6 to 9

Note: It is important to sharpen / expose the Fluting Wheel after 20 to 30 components to keep the wheel open. Sharpening can be done using the recommended $Al_2 0_3$ stick.

V_t = Feed Rate, (Traverse speed), a_e = Depth of cut (in feed), Q_w' = Specific Material removal rate

Recommended Process Parameters for your Fluting Application

Values in the table provide an insight into performance during the grinding process. You can find the perfect combination infeed (depth of cut) a_e and feed rate V_t for use with the HYBRID wheels. Feed Values depend on the work piece diameter, coolant used and machine power that can be utilised.

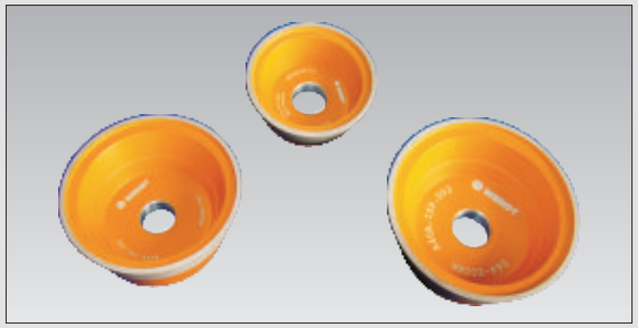
Traverse speed V_t (mm/min) Feed rate →

Infeed a_e (mm) Depth of Cut ↓	60	70	80	100	120	140	160	180	200
2,6	2,6	3,0	3,5	4,3	5,2	6,1	6,9	7,8	8,7
2,8	2,8	3,3	3,7	4,7	5,6	6,5	7,5	8,4	9,3
3,0	3,0	3,5	4,0	5,0	6,0	7,0	8,0	9,0	10,0
3,2	3,2	3,7	4,3	5,3	6,4	7,5	8,5	9,6	10,7
3,4	3,4	4,0	4,5	5,7	6,8	7,9	9,1	10,2	11,3
3,6	3,6	4,2	4,8	6,0	7,2	8,4	9,6	10,8	12,0
3,8	3,8	4,4	5,1	6,3	7,6	8,9	10,1	11,4	12,7
4,0	4,0	4,7	5,3	6,7	8,0	9,3	10,7	12,0	13,3
4,2	4,2	4,9	5,6	7,0	8,4	9,8	11,2	12,6	14,0
4,4	4,4	5,1	5,9	7,3	8,8	10,3	11,7	13,2	14,7
4,6	4,6	5,4	6,1	7,7	9,2	10,7	12,3	13,8	15,3
4,8	4,8	5,6	6,4	8,0	9,6	11,2	12,8	14,4	16,0
5,0	5,0	5,8	6,7	8,3	10,0	11,7	13,3	15,0	16,7
5,5	5,5	6,4	7,3	9,2	11,0	12,8	14,7	16,5	18,3
6,0	6,0	7,0	8,0	10,0	12,0	14,0	16,0	18,0	20,0
6,5	6,5	7,6	8,7	10,8	13,0	15,2	17,3	19,5	21,7
7,0	7,0	8,2	9,3	11,7	14,0	16,3	18,7	21,0	23,3
7,5	7,5	8,8	10,0	12,5	15,0	17,5	20,0	22,5	25,0

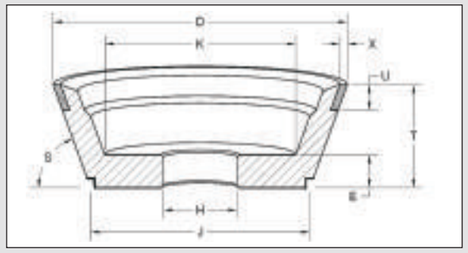
Reading Direction · Trial Start Parameter · Optimisation Level - 1 · Optimisation Level - 2 · Optimisation Level - 3

Clearance Grinding & OD Grinding

The EDGER Grinding wheels are optimised for clearance and relief grinding with good stock removal capability and profile consistency. This wheel has a predictable wear rate which can be programmed into the machine.



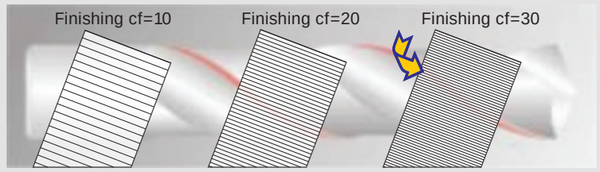
The 11V9 flaring cup wheel is available in three sizes .



Ordering Example.: A40A.ISP. 001 - 20H7 Bore

Recommended peripheral speeds for diamond wheels: (Wheel speed)

Narrow contact area/primary clearance angle:	25 – 35 m/sec.
Large contact area / secondary clearance angle:	20 – 30 m/sec.
Large contact area / relief grinding on carbide drills:	20 – 30 m/sec.

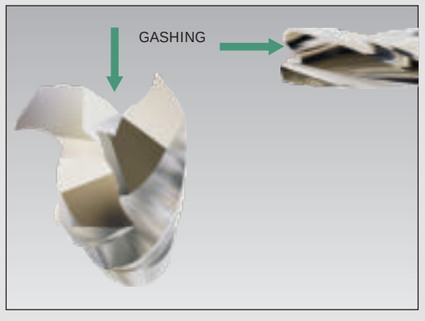


The 11V9 Wheel while grinding the OD, leaves grinding signs perpendicular to the work direction commonly called pitch. Closer the pitch finer the finish. The formula governing Surface Finish on OD of rotary tools is.

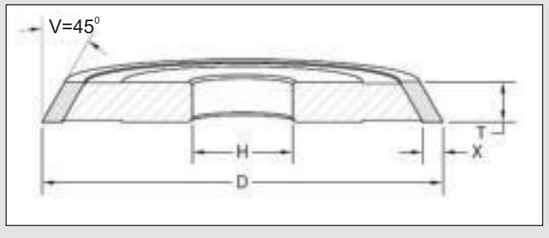
$$Cf = \frac{rpm}{\text{Feed rate (mm/min)}}$$

Gashing

Hybrid Wheels are very efficient in Gashing operation with high stock removal capacity and high profile consistency.



Wheel that is available for Gashing is in 1V1/45° design which is very popular.



Ordering Example.:
B15A.ISP. 004 - 20H7 Bore

HYBRID Wheels
Grinding Redefined

Truing

Truing of the grinding wheel is a very important operation. It helps in maintaining perfect geometry of the grinding wheel, with respect to the spindle. This ensures good grinding result on the carbide work piece.

However truing should be carried out on a separate profile grinding machine – preferably WDM 8, using a Aluminium Oxide Wheel.

Wheel Pack

Recommended Truing Parameters

Peripheral speed of the Hybrid Grinding Wheel:	3 – 5 m/sec.
Peripheral speed of the Al_2O_3Wheel:	15 – 28 m/sec.
Oscillation speed:	200 -1000 mm/min.
In feed:	0.01 – 0.07 mm per stroke

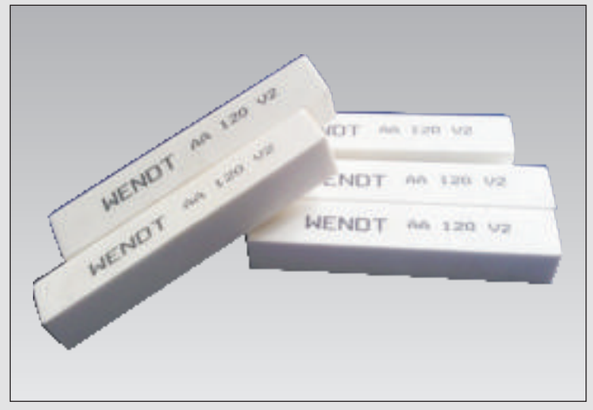
Grade of wheel to be used - for fluting wheels AA120
- for gashing / clearance angle wheels AA320

Dressing Stick recommendations for Sharpening / Exposing

It is important to sharpen the wheel after truing. This will expose the Diamond grains and hence increase the efficiency of the grinding wheel. Sharpening is also recommended when the power drawn by the CNC Grinder starts increasing. This is the first indication that the wheels need to be exposed.

Grade of Stick: 150 X25 X25 AA120 V2 (Standard)

- Exposing, application can be done either in dry or wet condition. Dry mode is more effective.
- During exposing make sure grinding wheel is rotating in same direction as grinding operation.



Case Study 1

ENDMILL	
Dimension	12 mmØ 25 mm Flute length
Depth of cut	2.4 mm/ flute to be done in 1 pass
Number of flutes	4
Material	Carbide
Machine	WALTER HELITRONICS (26kW)
Coolant	oil
Fluting operation	
Wheel used	1A1-125-10-6-D64 HYBRID- B10A.ISP.008
Feed rate	180mm/min
Wheel speed	19 SFPM
Time taken for fluting all 4 flutes	1 minute 5 seconds
End Gashing	
Wheel used	1V1-125-10/45^0- 6-D64-HYBRID – B15A.ISP..004
Feed rate	80mm/min
Wheel speed	19 SFPM
Time taken for Gashing	36 seconds
END geometry & OD relieving	
Wheel used	11V9-100-3-10-D64 EDGER - A40A.ISP.002
End cut primary feed rate	100mm/min
End cut Secondary feed rate	260mm/min
OD primary feed rate	260mm/min
OD secondary feed rate	250 mm/min
End cut Wheel surface speed	22 SFPM
OD Surface speed of wheel	22 SFPM
Time taken for end cutting and OD cutting	2minutes 50 seconds

Result
Total cycle time for the full tool to be completed

- 4 minutes 44 seconds (Including proofing).
- Q'w = 7.2 mm^3/mm/sec (Fluting)

Case Study 2

ENDMILL	
Dimension	11 mmØ 25.3 mm Flute length
Depth of cut	1.98 mm/ flute to be done in 1 pass
Number of flutes	4
Material	Carbide
Machine	TGT - GENUES 6 (9kW)
Coolant	oil
Fluting operation	
Wheel used	1A1-100-10-6-D64 HYBRID–B10A.ISP.003
Feed rate	110 mm/min
Wheel speed	16 Mts/sec
Time taken for fluting all 4 flutes	2 minute 7 seconds
End Gashing	
Wheel used	1V1-100-8 /45^0-6-D64-HYBRID – B15A.ISP..001
Feed rate	50mm/min Gash 120mm/min Widening
Wheel speed	20 mts/sec
Time taken for Gashing	55 seconds
END geometry & OD relieving	
Wheel used	11V9-100-3-10-D64 EDGER-A40A.ISP.002
End cut primary feed rate	100mm/min
End cut Secondary feed rate	90mm/min
OD primary feed rate	250mm/min
OD secondary feed rate	250 mm/min
End cut Wheel surface speed	25mts/sec
OD Surface speed of wheel	25mts/sec
Time taken for end cutting and OD cutting	2minutes 48 seconds

Result
Total cycle time for the full tool to be completed.

- 5 minutes 31 seconds (Including proofing).
- Q'w = 4 mm^3/mm/sec (Fluting)

Case Study 3

ENDMILL	
Dimension	12 mm Ø 25 mm Flute length
Depth of cut	2.4 mm/ flute
Done in 2 passes.	
Pass 1 Depth of cut	2.35 mm
Pass 2 Depth of cut	0.05 mm
Number of flutes	4
Material	Carbide
Machine	Rollomatic 620 XS (25kW)
Coolant	oil
Fluting operation (2 pass operation)	
Wheel used	1A1-150-10-6-D64 HYBRID – Special Execution
Feed rate for 1st Pass	160 mm/min
Feed rate for 2nd Pass	180 mm/min
Spindle load during first pass	7%
Spindle load during finish pass	2%
Wheel speed	19~25mts/sec
Time for 1st Fluting pass	40 sec
Time for 2nd fluting pass	12 seconds
• Time taken for full tool	6 minute 40 seconds
• Q'w	6 mm^3/mm/sec (Fluting)

Result achieved

- Total cycle time reduced from 12 minutes with Resin Wheels, to 6min 40sec with Hybrid Wheels
- Dressing stick needs to be applied after grinding 30 Endmill's. Else core /web diameter starts increasing.
- A total of 800 tools were ground with out removing the wheel pack for truing or giving compensation.
- Overall around 30% saving in cycle time and 200% benefit on dressing time.
- High Geometric Consistency on all Ground dimensions.

Case Study 4

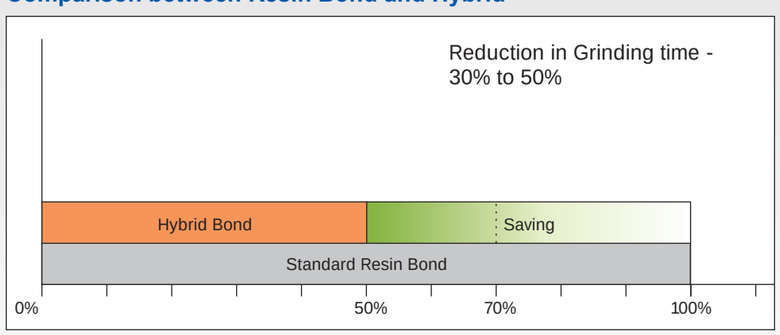
WENDT

CARBIDE Drill Fluting	
Dimension	18.8 mm Ø 45 mm Flute length
Depth of cut	6mm
Done in 2 passes.	
Pass 1 Depth of cut	3 mm
Pass 2 Depth of cut	3 mm
Number of flutes	2
Material	Carbide
Machine	Kennametal Eco Grind X^5 (5.5 HP~ 4.1kW)
Coolant	oil
Fluting operation (2 pass operation)	
Wheel used	1A1-125-10-6-D64 HYBRID – B10A.ISP.008
Feed rate for 1st Pass	30 mm/min
Feed rate for 2nd Pass	30 mm/min
Spindle load during pass	36% (50% during end of flute)
Wheel speed	19 mts/Sec
Time for Fluting	13 minutes 05 seconds

Result achieved

- Fluting time reduced from 22 minutes with Resin bond Wheels to 13min 05 seconds with Hybrid Wheels
- No vibration on the machine observed. Smooth and effortless grinding. (even with low spindle power of 5.5HP)
- Number of passes reduced from 4 with Resin bond wheels to 2 with Hybrid wheels.
- Spindle load reduction of almost 20%

Comparison between Resin Bond and Hybrid



Some important points we need to understand

- Greater the diamond wheel width used, lower is the wheel speed (V_c) to be maintained.
- In-feed / Depth of cut (a_e) is dependent on the spindle power of the machine,
- Feed rate / Traverse Speed (V_f) depends on the depth, length and spiral angle of the flute.

HYBRID Wheels
Grinding Redefined

Troubleshooting

Rough Surface	Vibration Marks	Burning	Grinding Cracks	High Wheel Wear /Poor Form Holding	Try this
X	X			X	Check the balancing of the wheel
X	X			X	Check the wheel geometry, centering
		X	X	X	Increase coolant velocity
		X	X	X	Check that coolant reaches grinding zone
		X	X	X	Check the cleaning of the coolant
	X	X	X	X	Check that the wheel is exposed properly
	X	X	X	X	Check that the right dressing stick is used
	X				Reduce the in feed of the wheel
X					Increase the wheel speed (V_c)
	X	X	X		Reduce the wheel speed (V_c)
X	X	X	X	X	Select a more suitable wheel specification

Speed Table for Grinding Wheels

Grinding Wheel		Peripheral speed in m/s – SFPM →													
Ø		10	15	20	25	30	35	40	45	50	60	80	100	120	150
mm /	Inch	1980	2970	3960	4950	5940	6930	7920	8910	9900	11880	15840	19800	23760	29700
20	3/4	9550	14330	19110	23890	28662	33440	38220	42990	47770	57320	76430	95540	114650	143310
25	1	7640	11600	15280	19100	22920	26740	30560	34380	38200	45840	61120	76400	91680	114650
40	1,5/8	4770	7160	9550	11930	14320	17610	19100	21480	23870	28650	38200	47740	57300	71660
50	2	3820	5730	7640	9550	11460	13370	15280	17190	19100	22920	30560	38200	45840	57330
75	3	2550	3820	6000	6370	7640	8920	10190	11460	12740	15290	20380	25480	30570	38210
100	4	1910	2860	3820	4770	5730	6680	7640	8590	9550	11460	15280	19100	22920	28670
125	5	1520	2290	3050	3820	4580	5340	6110	6870	7640	9160	12220	15280	18320	22930
150	6	1270	1910	2540	3180	3820	4450	5090	5730	6360	7640	10180	12720	15280	19110
175	7	1090	1640	2180	2730	3280	3820	4370	4910	5460	6550	8740	10920	13100	16380
200	8	950	1430	1910	2380	2860	3340	3820	4290	4770	5730	7640	9540	11460	14330
250	10	760	1140	1520	1910	2290	2670	3050	3430	3820	4580	6110	7640	9160	11460

↓ Peripheral speed in rpm

Since continuous improvements are made, specifications are subject to change without notice.

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WENDT/HYBRID WHEELS/1209/1/SWE