



GRAPHITE GRADES FOR ELECTRICAL DISCHARGE MACHINING (EDM)



ellor®

+ It's all about the right balance.

With its leading experience in EDM, Mersen has developed a complete range of graphite grades aiming to answer to the widest range of electrode designs and workpiece materials.

The selection of the right graphite grades will depend on numerous factors. Mersen's expertise will guide you to the proper conclusion. There are 4 key factors that will largely impact your selection.

GRAPHITE VS COPPER

- Easy to machine**
it is much easier to fabricate an electrode out of graphite than copper
- 5 times lighter**
graphite has a low density so electrodes weigh less. This is a critical factor as electrodes become larger
- Greater geometrical stability**
due to its low Coefficient of Thermal Expansion graphite will not expand as much as copper, allowing it to maintain its critical dimensions
- Metal Removal Rate is doubled**
graphite has a metal removal rate 2 times higher than copper with lower electrode wear
- Much less Wear**
graphite does not melt but sublimates at 3,400° C, providing much greater wear resistance than the low melting point of copper

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WEAR RESISTANCE

Or how long will the electrode be able to maintain the level of details during the spark erosion process?

A good Wear Resistance control of your graphite electrode means fewer electrodes to do the same job, less time and decreased manufacturing cost.

Low graphite wear will determine the accuracy of the work. The material loss is more significant with coarse grain graphites since the amount of wear will be greater than with fine grain graphite at the same operating parameters.



METAL REMOVAL RATE

Or how fast will the graphite electrode remove material during the spark erosion process?

Typically the larger the grain of the electrode graphite, the higher the Metal Removal Rate.

Typically, with each spark, a fine grain graphite grade will remove less metal on the work piece than a coarse grain graphite but will have a smoother surface finish.



SURFACE FINISH

Or how smooth should your workpiece surface be?

Fine grain graphite grades will be the preferred choice to erode very fine and smooth surfaces up to 0,4 Ra(µm). The greatest advantages are when complicated cavities are involved. Such cavities are difficult, time consuming and therefore expensive to polish manually.

When a very high quality finish is needed, the operator follows a high-speed roughing cut with one or more finishing - skimming, to use EDM terminology - cuts. By taking multiple skimming passes, EDM finish quality can become almost mirror-like.



MACHINABILITY

Or how easy the material can be machined into fine details with good finish?

Graphite grades are not equal when it comes to machining them into electrodes. Ultra-fine particle sizes are key to achieve a perfect accuracy of the electrode. Time to produce an electrode is highly related to:

- > the grain size of the grade
- > its strength along with the complexity of the electrode to be machined.

01

UNIVERSAL FINE GRAIN GRADE

For high metal removal rate with excellent performance ratio

ellor[®]+18
ellor[®]+20

YOUR BENEFITS:

- Production cycles shortened with high removal rate capacities
- Excellent machinability
- Best choice for medium surface finish
- Ellor[®] +18 recommended for die casting molds in aluminium

WEAR RESISTANCE

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METAL REMOVAL RATE

5/5

SURFACE FINISH

3/5

MACHINABILITY

4/5



	GRAIN SIZE		HARDNESS SHORE	HARDNESS ROCKWELL	DENSITY		FLEXURAL STRENGTH		ELECTRICAL RESISTIVITY	
	µm	inch			g/cm ³	lbs/ft ³	MPa	psi	µohm.cm	ohm.inch
ellor[®]+18	12	0.0005	62	98 L	1,78	111	45	6,500	1370	0.00054
ellor[®]+20	11	0.0005	65	72 H	1,81	112	52	7,500	1240	0.00049

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UNIVERSAL SUPERFINE GRAIN GRADE

multi-skilled,
multi-talented.
You will love it.

ellor[®]+25

YOUR BENEFITS:

- Good removal rate capabilities
- Superior strength and wear resistance characteristics for longer life time
- Easy to machine
- Excellent surface finish up to 1,6 Ra(μm)

WEAR RESISTANCE

4/5

METAL REMOVAL RATE

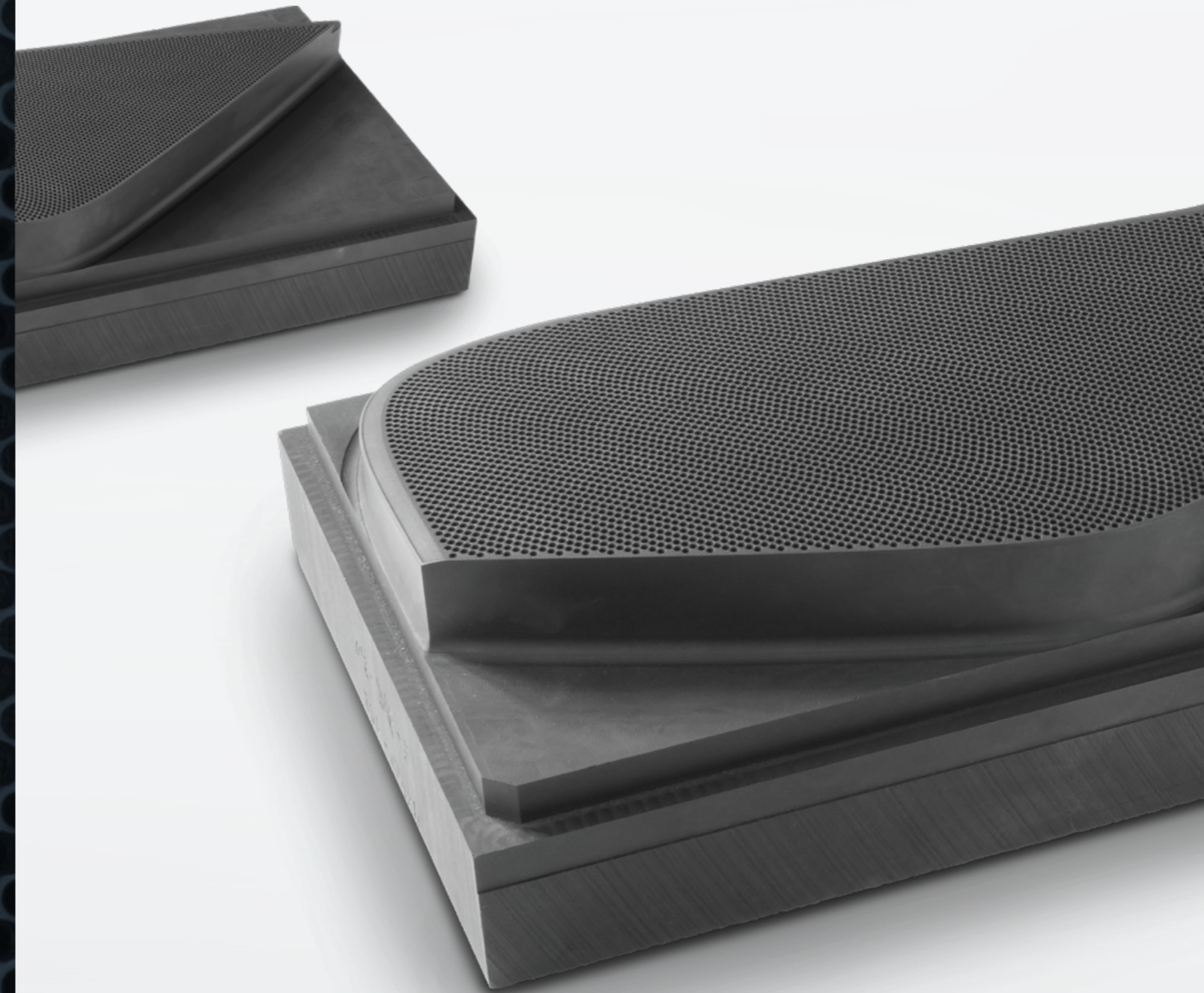
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SURFACE FINISH

4/5

MACHINABILITY

4,5/5



GRAIN SIZE	HARDNESS SHORE	HARDNESS ROCKWELL	DENSITY		FLEXURAL STRENGTH		ELECTRICAL RESISTIVITY	
			g/cm ³	lbs/ft ³	MPa	psi	μohm.cm	ohm.inch
9 μm inch	65	80 H	1,83	114	55	8,000	1220	0.00048

ellor[®]+25

ELLOR[®] + 25 also exists in copper impregnated graphite grade for a higher electrical conductivity and improved performance

03

EXCEPTIONAL SUPERFINE GRAIN GRADES

for outstanding performances

YOUR BENEFITS:

- Exceptional surface finish up to 0,56 Ra(µm)
- Outstanding strength and wear resistance to keep a high performance even with intricate designs
- Excellent Metal Removal Rate (MRR)
- Preferred grades from mobile phone manufacturers

WEAR RESISTANCE



METAL REMOVAL RATE



SURFACE FINISH



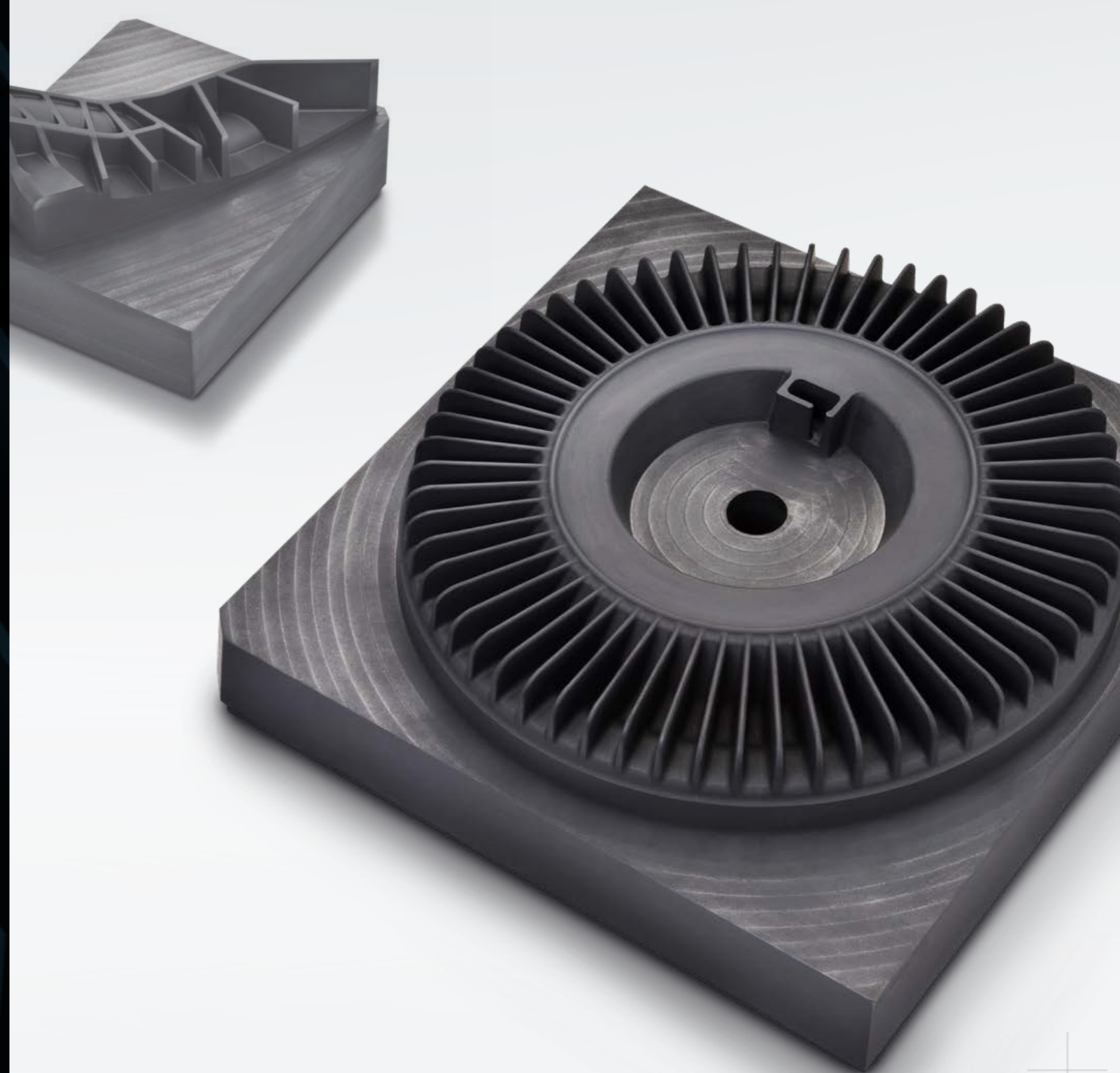
MACHINABILITY



ellor[®]+30

ellor[®]+40

ellor[®]+50



	GRAIN SIZE		HARDNESS SHORE	HARDNESS ROCKWELL	DENSITY		FLEXURAL STRENGTH		ELECTRICAL RESISTIVITY	
	µm	inch			g/cm ³	lbs/ft ³	MPa	psi	µohm.cm	ohm.inch

ellor[®]+30	8	0.0004	<80	90 H	1,84	115	65	9,400	1220	0.00048
ellor[®]+40	7	0.0003	60	75 H	1,78	111	60	8,700	1270	0.00050
ellor[®]+50	5	0.0002	80	95 H	1,86	116	76	11,000	1370	0.00054

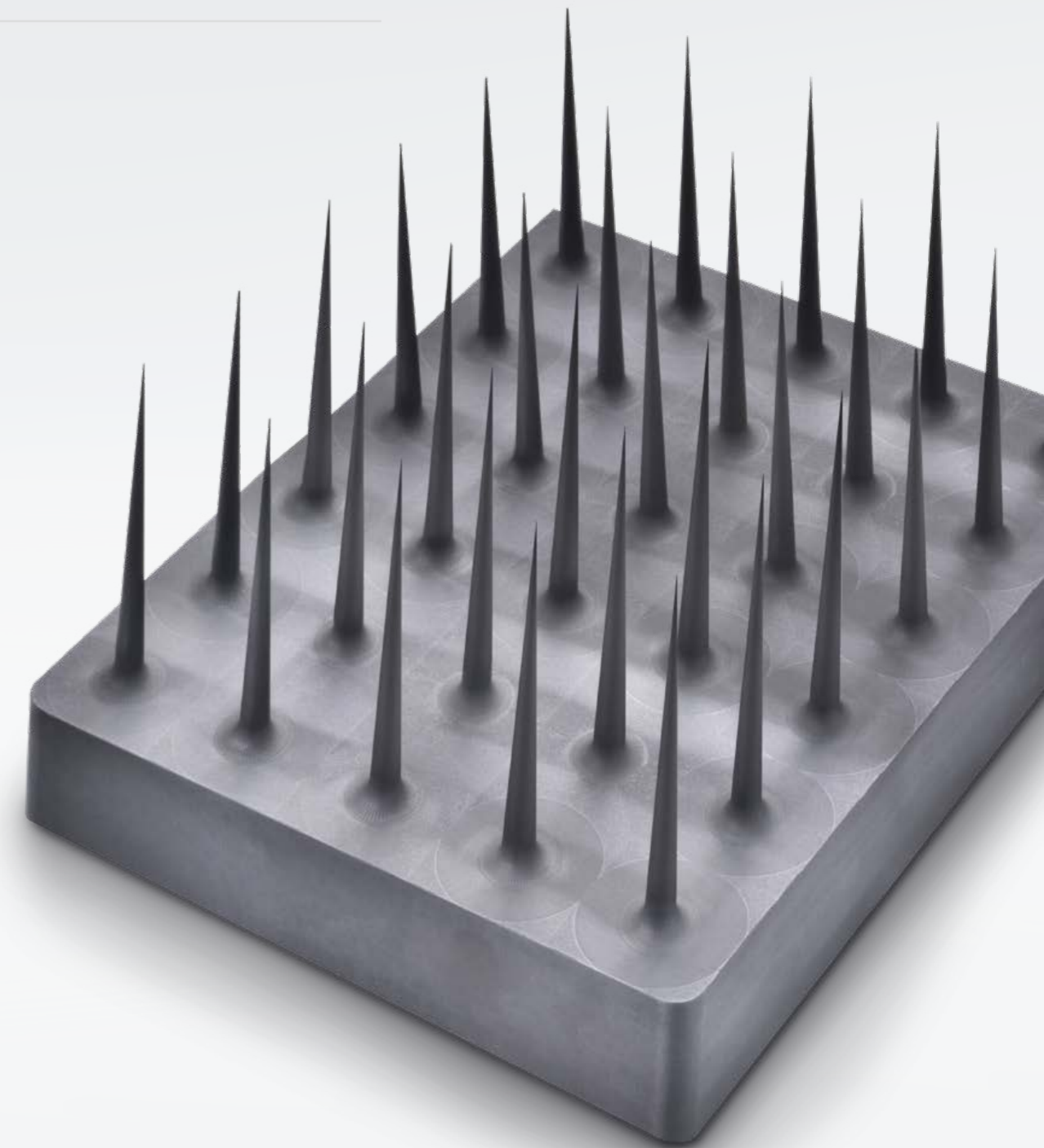
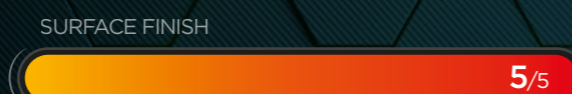
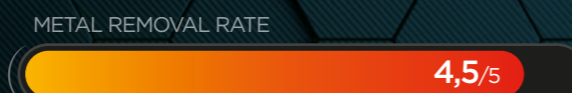
04

THE PREMIUM ULTRAFINE GRAIN GRAPHITE

The star...call it Dark Star

YOUR BENEFITS:

- Exceptional surface finish up to 0,40 Ra(μm)
- Outstanding strength and wear resistance to keep a high performance even with intricate designs



	GRAIN SIZE		HARDNESS SHORE	HARDNESS ROCKWELL	DENSITY		FLEXURAL STRENGTH		ELECTRICAL RESISTIVITY	
	μm	inch			g/cm ³	lbs/ft ³	MPa	psi	μohm.cm	ohm.inch
ellor® +DS4	4	0.0002	72	95 H	1,88	117	90	13,000	1270	0.00050
ellor® +DS4C	4	<0.0002	75	110 H	2,85	178	117	17,000	224	0.00009

A COMPLETE OFFERING OF EDM GRADES TO COVER ALL YOUR NEEDS

	AVERAGE GRAIN SIZE		DENSITY		HARDNESS ROCKWELL	HARDNESS SHORE	FLEXURAL STRENGTH		ELECTRICAL RESISTIVITY		MAXIMUM BLOCK SIZES	
	μm	inch	g/cm ³	lbs/ft ³			MPa	psi	μohm.cm	ohm.inch	mm	inch
ellor[®]+18	12	0.0005	1,78	111	98 L	62	45	6,500	1370	0.00054	305x610x2030	12x24x80
ellor[®]+20	11	0.0005	1,81	112	72 L	65	52	7,500	1240	0.00049	305x610x2030	12x24x80
ellor[®]+25	9	0.0004	1,83	114	80 H	65	55	8,000	1220	0.00048	305x610x2030	12x24x80
ellor[®]+30	8	0.0003	1,84	115	90 H	<80	65	9,400	1220	0.00048	305x610x1830	12x24x72
ellor[®]+40	7	0.0003	1,78	111	75 H	60	60	8,700	1270	0.00050	305x610x915	12x24x36
ellor[®]+50	5	0.0002	1,86	116	95 H	80	76	11,000	1370	0.00054	305x610x915	12x12x36
ellor[®]+DS4	4	<0.0002	1,88	117	95 H	72	90	13,000	1270	0.00050	305x610x102	4x12x24
ellor[®]+DS4C	4	<0.0002	2,85	178	110 H	75	117	17,000	224	0.00009	305x203x51	2x8x12

RECOMMENDED GRADES

● SUITABLE
● APPLICABLE

		GRADE	GRADE	GRADE	GRADE	GRADE	GRADE	
		ellor [®] +18	ellor [®] +20	ellor [®] +25	ellor [®] +30	ellor [®] +40	ellor [®] +50	ellor [®] +DS4
OPERATIONS	WIRE EDM			●	●	●	●	●
	DEEP HOLES			●	●	●	●	●
	FINES RIBS			●	●	●	●	●
MATERIAL TO BE MACHINED	STEEL	●	●	●	●	●	●	●
	REFRACTORY STEEL	●	●	●	●	●	●	●
	TITANIUM, MOLYBDENUM, COOPER			●	●	●	●	●
	TUNGSTEN, CARBIDE				●	●	●	●

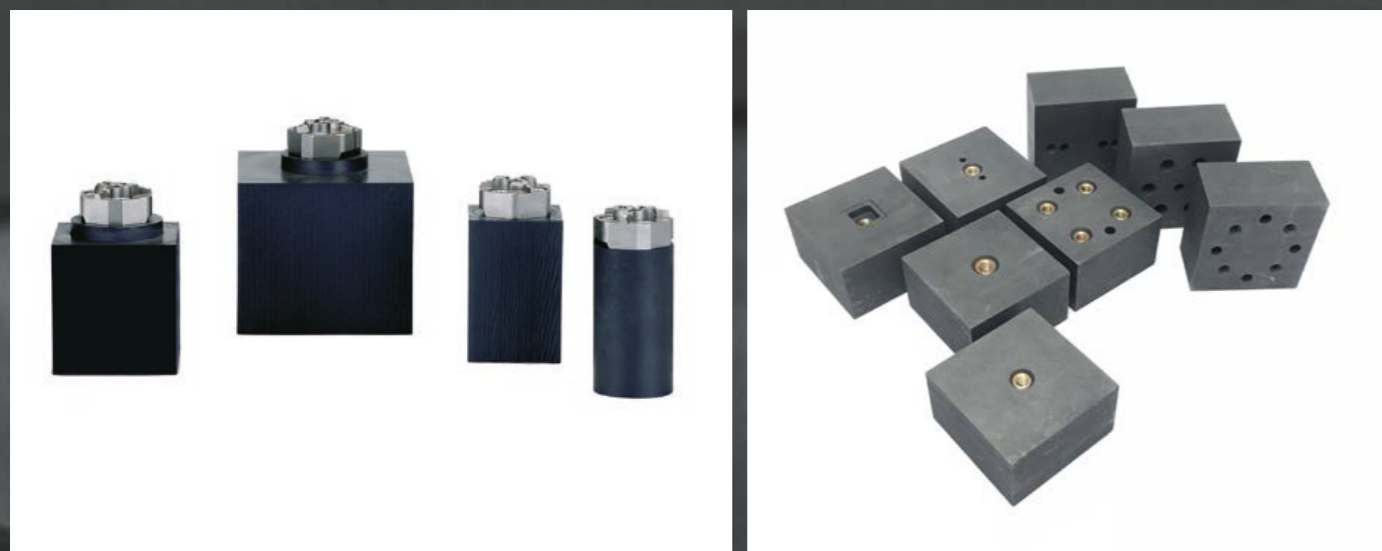
SURFACE FINISH ACHIEVABLE ON STEEL WITH ELLOR[®] GRAPHITE

	FINISHING MODE			INTERMEDIATE						ROUGHING		
	ellor [®] +DS4			ellor [®] +50						ellor [®] +30		
				ellor [®] +40						ellor [®] +25		
				ellor [®] +20						ellor [®] +18		
VDI 3400	12	15	18	21	24	27	30	33	36	39	42	45
Ra[μm]	0.40	0.56	0,80	1.12	1.60	2.24	3.15	4.50	6.30	9.00	12.50	18.00
Ra[μinch]	16	22	31	44	63	88	124	177	248	354	492	709

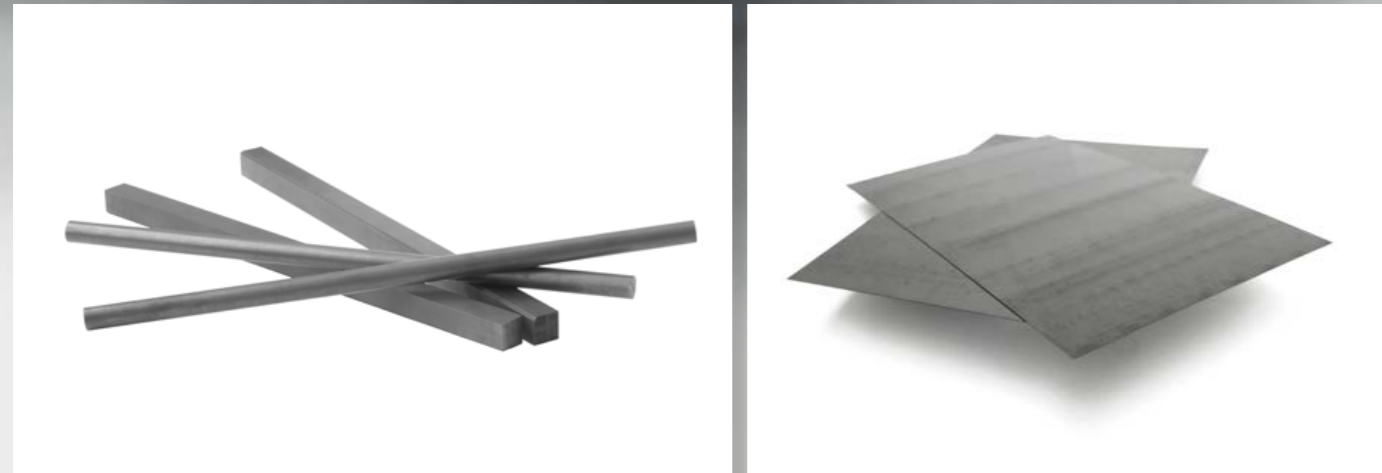
OUR RECOMMENDATIONS TO GET THE MOST OF ELLOR® ELECTRODES

Good EDM results require not only the proper selection of EDM material, but also proper machine settings, such as peak current, on time, off time, gap size, electrode polarity and most importantly the flushing conditions.

READY TO CLAMP ELECTRODES



SQUARE BAR, ROUND BARS AND FOIL SHEETS



TIPS FOR ERODING WITH GRAPHITE ELECTRODES

ROUGHING

- High discharge current causes high erosion and a rough surface

SIZING

- Low discharge current causes a low removal and a fine surface

SURFACE ROUGHNESS

- High discharge current causes high erosion and a rough surface
- Low discharge current causes a low removal and a fine surface
- Surfaces up to VDI 12 are possible, if given the right selection of graphite

CONTOUR AND DIMENSIONAL ACCURACY

- Is always given due to the low thermal expansion of graphite
- Graphite is thermally stable and distortion-free

TIME SAVING

- Through linking multiple electrodes

AVOID ARCING

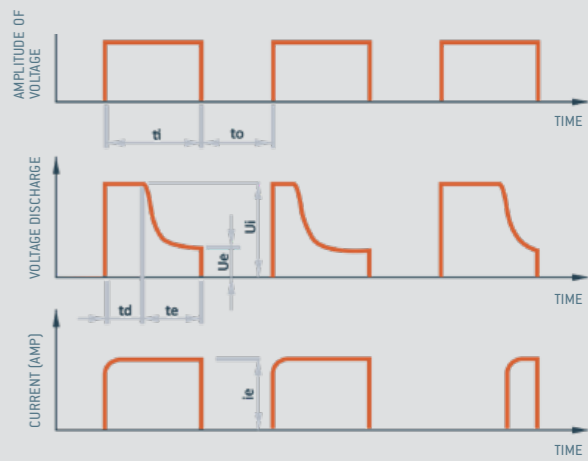
- Improve pulse duration
- Lower downtime
- Increase set point
- Improve flushing conditions

ELECTRODE WEAR

- Decreases with increasing pulse duration and decreasing pulse break

EDM DIE SINKING PROCESS

CURRENT AND VOLTAGE SCHEMATIC VIEW



- (ti) pulse duration [S]
- (to) pause duration [S]
- (te) discharging duration [S]
- (Ui) open circuit voltage [V]
- (Ue) voltage discharge [V]
- (ie) current [Amp]
- (td) discharge delay time [S]

MACHINING RECOMMENDATION

MACHINING		SPEED m/min	ADVANCE mm per revolution	DEPTH OF CUTTING in mm
MILLING	ROUGHING	800–1000	0,1–0,8	
	FINISH	1000	<0,09	
TURNING	ROUGHING	100–250	0,3–0,45	5–19
	FINISH	250–450	0,06–0,15	0,1–0,5
RECTIFICATION		100–2300	150–800	<3
SAWING		300–500	300–400	

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