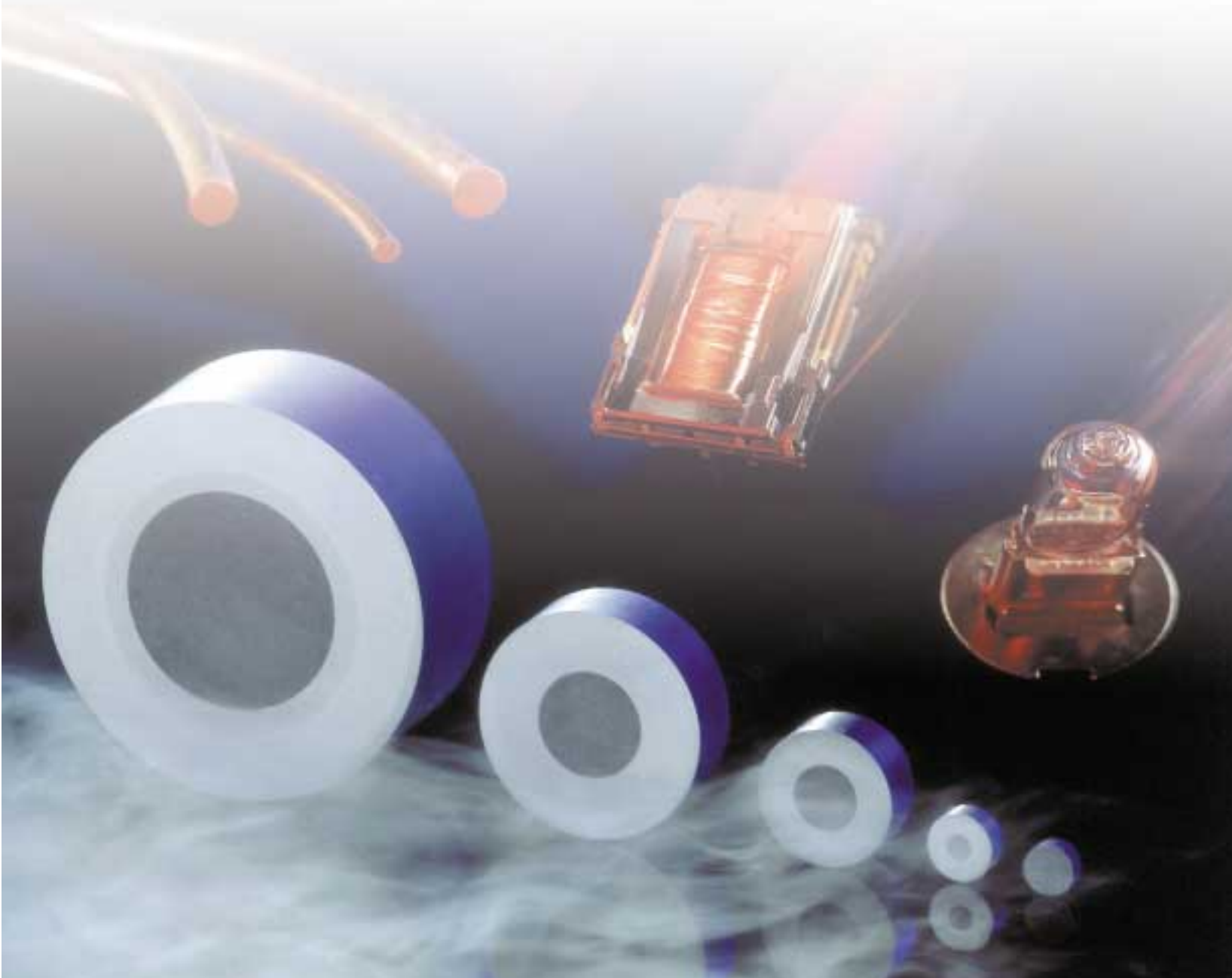
Diamond Innovations

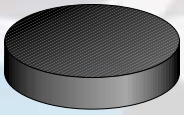
Compax* Diamond Die Blanks

Self-Supported and
Tungsten Carbide Supported Blanks
for Wire Drawing Applications



Compax Diamond Die Blanks Product Groups

Self Supported Compax Diamond Blanks



Free standing polycrystalline (PCD) diamond cylinders

Grain Sizes - Average Particle Size

Product Description

TS Grade
Catalyst metal removed.
Thermally stable up to 1200°C in an inert or reducing atmosphere.
Can be mounted using high temperature, high strength metal setting powders.
Not electrically conductive: EDM not recommended for piercing/shaping.
Use laser, ultrasonic or needle piercing/shaping methods.

MF Grade
Metal filled, contains catalyst metal.
Thermally stable up to 700°C.
Do not exceed 700°C in blank mounting.
Electrically conductive: EDM, laser, ultrasonic or needle methods for piercing/shaping die bore may be used.

Polishing

Diamond Micron Powder SJK-5 or GMM series recommended for final die bore shaping and polishing.

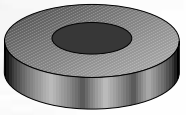
For superior polish use 0.25 µm or 0.5 µm graded diamond fines.

Recommended Applications

TS or MF Grade
Drawing of high carbon steel tire cord.
Drawing of smaller diameter and critical surface finish nonferrous and ferrous wires.

TS Grade
High temperature drawing of tungsten/molybdenum.

Tungsten Carbide Supported Compax Diamond Blanks



Polycrystalline diamond (PCD) core integrally bonded to a tungsten carbide support ring

Grain Sizes - Average Particle Size

Product Description

All blanks contain metal catalyst in PCD structure.
Do not exceed 700°C in die mounting operations.

Electrically conductive: Diamond core may be pierced using either EDM, laser, ultrasonic or needle methods.

Profiling of die geometry is normally performed using shaped needles with EDM or ultrasonic machines with diamond abrasives.

Polishing

Diamond Micron Powder SJK-5 or GMM series recommended for final die bore shaping and polishing.

For superior polish use 0.25 µm or 0.5 µm graded diamond fines.

Recommended Applications

25 µm and 50 µm Grain Sizes
Intermediate and rod break down drawing of copper, aluminum and other nonferrous materials.

5 µm and 25 µm Grain Sizes
Nonferrous and ferrous intermediate and fine wires.
Applications where superior surface quality is a must.

3 µm and 5 µm Grain Sizes
Nonferrous and ferrous wire in finer sizes.
Critical surface finish applications.

Compax* Diamond Die Blanks

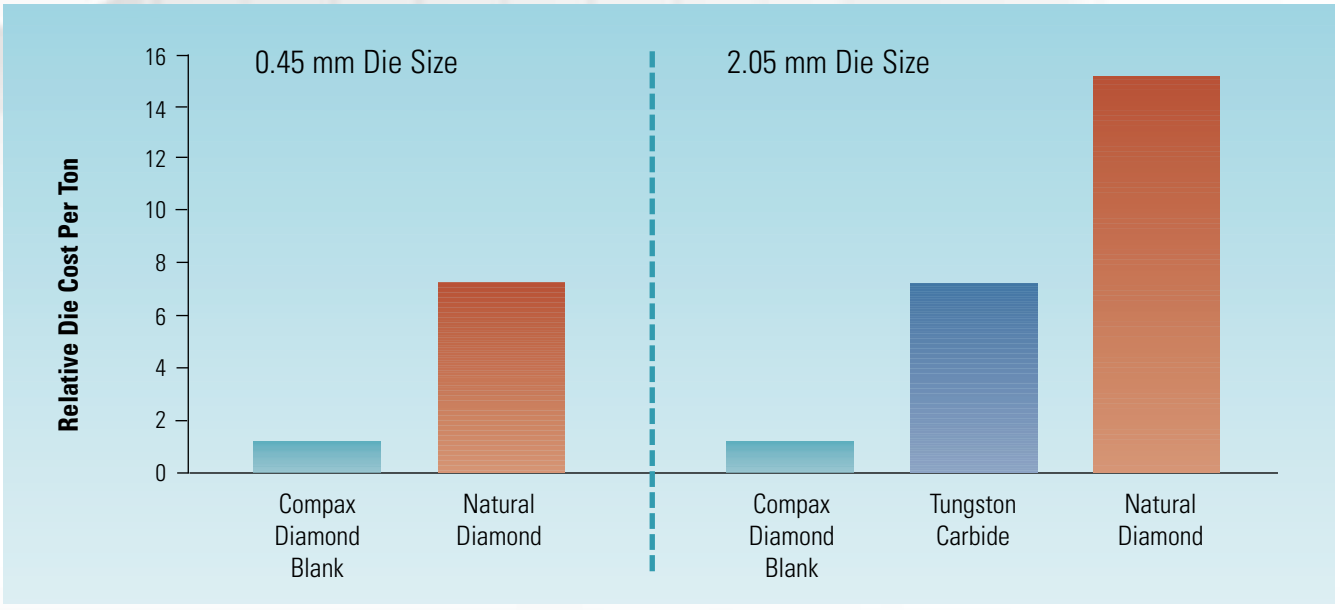
Wiring-up your Productivty

Polycrystalline diamond Compax die blanks are produced in a Six Sigma controlled high pressure/ high temperature process. Compax products consist of randomly orientated micron size diamond crystals, with extremely high diamond-to-diamond bonding. This important physical property provides Compax die blanks with uniformly high, non-directional hardness as well as unmatched mechanical strength and wear resistance.

Simply Better than Nature

Compax die blanks offer significant advantages compared to natural diamond. Most importantly, Compax blanks have no cleavage planes, which makes them highly resistant to breakage. Due to their randomly orientated crystals uneven wear is successfully prevented. These unique product properties and characteristics result in impressive productivity and cost saving benefits in a wide range of nonferrous, ferrous and high temperature wire drawing applications.

Comparative Die Costs for Drawing Copper Wire



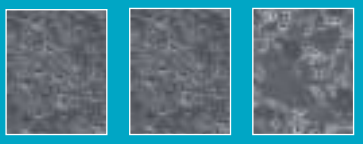
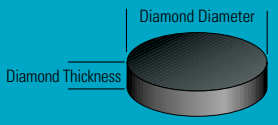
Keys to Success
Excellent Sinter Quality & Homogenic Distribution of Pore Sizes

Consistency and performance in wire drawing applications depend on two main characteristics of a diamond die blank: Excellent sinter quality and a perfectly homogenic distribution of pore sizes within the polycrystalline diamond structure. This provides the die manufacturer with the capability to generate a high quality polished surface in minimal cycle time and a consistent long die life.

Compax Die Blank Characteristics	Proven Benefits for the End User
High strength and wear resistance through unmatched crystal bonding	Longer die life More recuts Greater machine uptime
Uniform hardness and wear resistance in all directions	Highly improved wire shape finish and dimension control
Large range of die blank and grain sizes	Best choice for each application in a wide range of nonferrous and ferrous wire drawing

Product Dimensions – Availability Chart

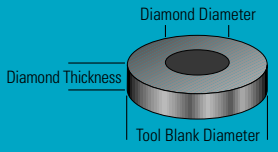
Self-Supported Die Blanks

ADDMA[1] Designation	Nominal Diamond Diameter x Thickness [mm x mm]	Product Designation / Average Grain Size			Total Blank Diameter
					
		5 µm	5 µm	25 µm	
D-6	3.1 x 1.0	5010-TS	5010-MF	5010-TSC	(Not Applicable)
D-12	3.1 x 1.5	5015-TS	5015-MF	5015-TSC	
D-15	5.2 x 2.5	5025-TS	5025-MF	5025-TSC	
D-18	5.2 x 3.5	5035-TS	5035-MF	5035-TSC	

[1] American Diamond Die Manufacturers' Association

TS = Thermally Stable MF = Metal Filled TSC = Thermally Stable C = Coarse (25 µm)

Tungsten Carbide Supported Die Blanks

ADDMA[1] Designation	Nominal Diamond Diameter x Thickness [mm x mm]	Product Designation / Average Grain Size				Total Blank Diameter
						
		3 µm	5 µm	25 µm	50 µm	
D-12	1.5 x 1.5			5235		3.99 ± 0.013
D-15	4.0 x 2.3	5823		5223	5430	8.12 ± 0.013
D-18	4.0 x 2.9	5829		5229	5435	8.12 ± 0.013
D-21	7.0 x 4.0		5840	5240	5530	13.65 ± 0.013
D-24	7.0 x 5.3		5853	5253	5535	13.65 ± 0.013
	13.0 x 7.0			5225	5725	24.13 ± 0.025
D-27	13.0 x 8.7			5208	5730	24.13 ± 0.025
D-30	13.0 x 11.6			5211	5735	24.13 ± 0.025
	18.6 x 13.5			5913		34.00 ± 0.025
D-33	18.6 x 15.5			5915		34.00 ± 0.025
	18.6 x 17.5			5917		34.00 ± 0.025
D-36	18.6 x 18.5			5918		34.00 ± 0.025

Physical Properties of PCD compared to WC

		PCD*	WC
Compressive Strength	(106 psi)	1.0 - 1.1	0.6 - 0.8
Elastic Modulus	(x106 psi)	120 - 160	85 - 100
Knoop Hardness	(Gpa)	50	13
Thermal Conductivity	(W/cmk)	5 - 6	1

Diamond grains exhibit a high degree of diamond to diamond bonding.
PCD is 87 - 94 % diamond by volume, depending on grain size.

- **Parallelism** is measured as maximum thickness variation of top to bottom surfaces of ring.
- **Perpendicularity** is measured in mm and as the angle between the sides and top/bottom surfaces.
- **Roundness** is measured as the difference between the smallest OD and largest OD measurement.
- **Concentricity** is measured as the maximum wall variation between ID and OD of the carbide ring.

Product Dimensions [mm]

Diamond Diameter	Diamond Thickness	Parallelism [mm]	Roundness [mm]	Perpendicularity [mm]	Concentricity [mm]
3.1 ± 0.38	1.0 ± 0.13	0.08	(Within Diameter Limits)	0.13	(Not Applicable)
3.1 ± 0.38	1.5 ± 0.13	0.08		0.13	
5.2 ± 0.64	2.5 ± 0.13	0.08		0.25	
5.2 ± 0.64	3.5 ± 0.13	0.08		0.25	

Product Dimensions [mm]

Diamond Diameter (minimum)	Diamond Thickness	Parallelism [mm]	Roundness [mm]	Perpendicularity [mm]	Concentricity [mm]
1.4	1.50 ± 0.10	0.05	0.010	0.05	0.20
3.8	2.24 ± 0.05	0.05	0.010	0.08	0.40
3.8	2.84 ± 0.05	0.05	0.010	0.10	0.40
6.8	3.86 ± 0.05	0.05	0.010	0.14	0.50
6.8	5.13 ± 0.05	0.05	0.010	0.18	0.50
12.7	6.98 ± 0.25	0.05	0.050	0.30	0.60
12.7	8.70 ± 0.25	0.10	0.050	0.30	0.60
12.7	11.60 ± 0.25	0.10	0.050	0.40	0.60
18.2	13.50 ± 0.50	0.10	0.050	0.45	0.75
18.2	15.50 ± 0.50	0.10	0.050	0.52	0.75
18.2	17.50 ± 0.50	0.10	0.050	0.59	0.75
18.2	18.50 ± 0.50	0.10	0.050	0.62	0.75

Wire Drawing Application Guidelines[1]

Wire Type	Wire Area Wire Size Range [mm]	Percent Reduction	Die Geometry: Reduction Angle	Die Geometry: Bearing Length [%])	Drawing Speed [m/min]	Relative Performance[2] versus: Tungsten Carbide	Relative Performance[2] versus: Single Crystal Diamond
Nonferrous							
• Copper	1.84 - 7.60	20 - 35	16 - 25	10 - 25	600 - 2500	200 - 500X	–
	0.05 - 2.05	18 - 21	16 - 20	10 - 25	600 - 3300	–	5 - 15X
• Aluminum	1.84 - 7.60	18 - 30	16 - 25	10 - 25	600 - 1500	100 - 200X	–
	0.20 - 2.05	15 - 21	16 - 20	10 - 25	600 - 2000	–	3 - 5X
• Aluminum Magnesium Alloy	1.84 - 4.76	18 - 22	16 - 20	15 - 30	350 - 650	100 - 200X	–
• Tin-Plated Copper (electroplated)	0.20 - 1.80	15 - 26	18 - 22	10 - 25	300 - 1000	100 - 200X	5 - 10X
• Nickel 200	0.33 - 1.65	20 - 30	16 - 20	15 - 30	200 - 500	–	6 - 10X
• Tungsten	0.12 - 0.62	18 - 22	12 - 16	20 - 40	30 - 80	–	3 - 6X
• Molybdenum	0.12 - 1.02	18 - 22	12 - 16	20 - 40	30 - 80	50 - 80X	3 - 6X
Ferrous							
• Galvanized High Carbon Steel	0.24 - 1.05	15 - 20	10 - 14	20 - 40	400 - 800	30 - 50X	–
• Brass-Plated High Carbon Steel Tire Cord	0.17 - 0.40	18 - 21	10 - 16	20 - 40	600 - 1000	10 - 30X	–
• Stainless Steel 316	0.18 - 1.60	18 - 21	10 - 14	20 - 40	200 - 600	10 - 20X	4 - 8X
• Stainless Steel 302	0.24 - 1.60	18 - 21	10 - 14	20 - 40	200 - 600	8 - 15X	2 - 4X
• Ni-Cr-Fe Alloy (60:15:25)	0.20 - 1.20	18 - 26	10 - 14	20 - 40	200 - 600	30 - 50X	4 - 6X
• Low Carbon Steel	0.88 - 2.10	18 - 21	8 - 14	20 - 40	400 - 800	30 - 70X	–

[1] The application guidelines are recommended starting parameters with companies optimizing parameters through experience.

[2] Range in relative die performance is due primarily to difference in wire compositions, properties and operating conditions by companies.

Compax Wire Die User Guidelines

- Recut or repolish die on observation of wear ring in area of wire contact to maximize die life.
- Filter lubricant to remove metal fines to maximize lubricant flow, wire finish and die life.
- Do not exceed maximum die size recommendation for blank size.
- Decrease bearing length for higher speed drawing.
- Use finer grain die blanks for improved wire surface finish and when drawing ferrous and plated wires.
- Use coarser grain die blanks for drawing larger size nonferrous wire to provide longer die life and improved wire dimensional control.
- In high temperature drawing of tungsten and molybdenum wire maintain reducing atmosphere in drawing zone to minimize detrimental oxidation effects and maximize die life.
- Use matched elongation die sets in multi-wire drawing machines.

Diamond Innovations' quality systems are registered under ISO 9002.

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