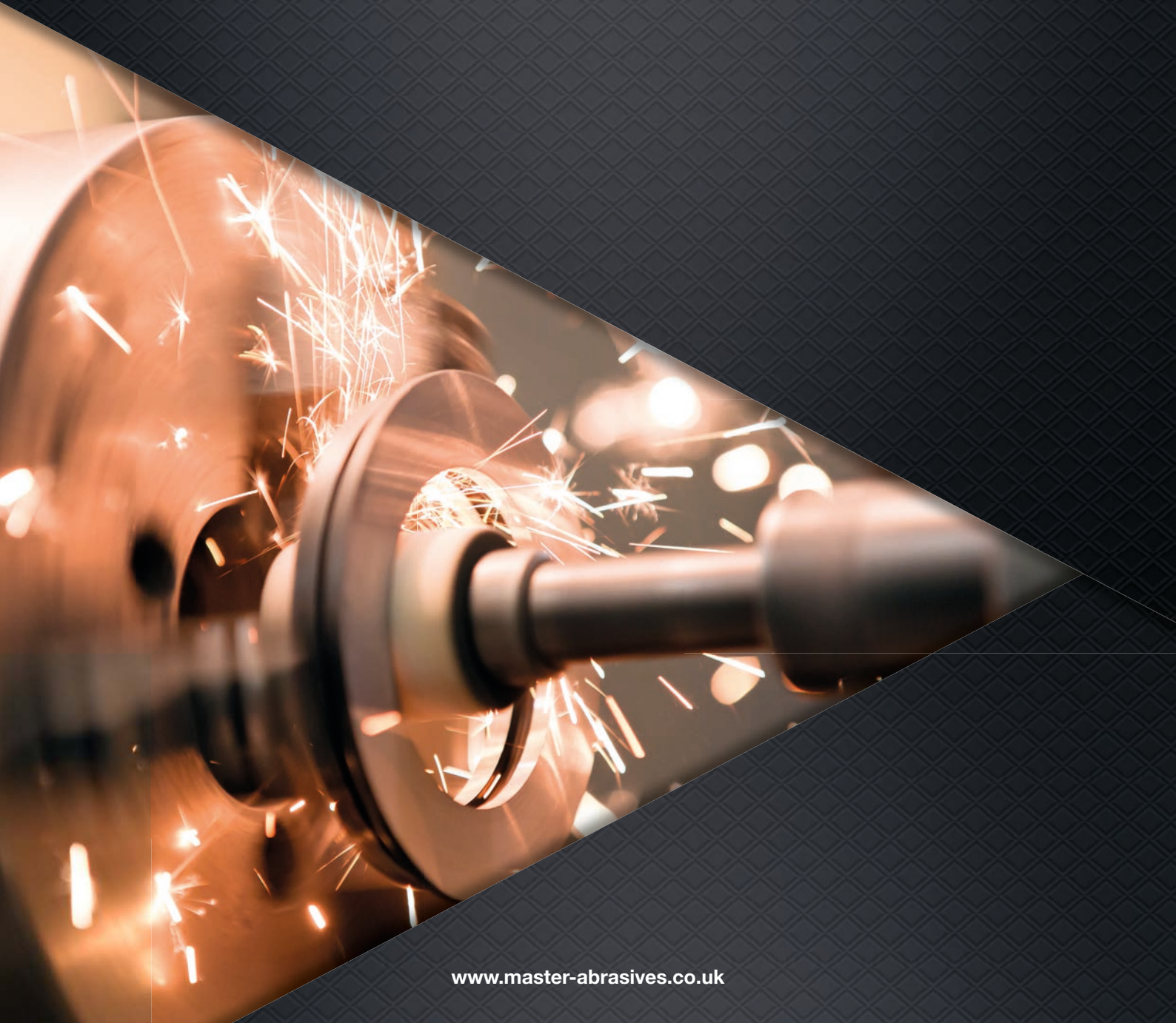


MASTER[®]

Superabrasives Products

SOLUTIONS FOR INDUSTRY



Introduction

Master Abrasives

Master Abrasives has a hard and long earned reputation in the UK abrasives market for providing solutions with high-quality products and professional service. Established in Daventry in 1967, we have served British industry for nearly half a century, now as an independent UK owned abrasive company with an extensive range of abrasive products and applications engineering support. The Master® brand provides solutions for industry, offering high quality as well as affordable products and services.

Master branded superabrasives products are manufactured to provide consistently high quality. The product range is extensive, covering vitrified, resin and metal bonds, electroplated products, Cubic Boron Nitride (CBN) and Diamond grades and dressing tools and equipment.

Our application engineers can assess your application needs and work with you to develop both the product and process with a view to reducing your costs. Offering high-quality products at competitive prices backed up by a professional and technical service, we aim to provide ultimate solutions for industry.



Characteristics of Superabrasives

Hardest materials on earth

Cubic Boron Nitride (CBN) and Diamond are harder than any other materials found on earth and are therefore ideal for use as abrasives. CBN is a man made material, using the same high temperature and pressure technology developed for the synthesis of Diamond. Boron and Nitrogen are combined to form Cubic Boron Nitride. The ability of Diamond to grind nonferrous materials like carbides and ceramics is well known. It was the development of CBN that revolutionised the grinding techniques for steel, cast iron and the difficult to grind superalloys. New CBN and Diamond types are constantly being developed by leading manufacturers to suit specialised applications and to offer improved performance.

Crystal Shapes

The blocky shapes of the CBN and Diamond crystals and the way they break down ensures that a consistently sharp cutting face is in contact with the workpiece. This is in clear contrast to the rounded shapes of conventional Aluminium Oxide and Silicon Carbide crystals that provide less sharp cutting faces.

Crystal Hardness

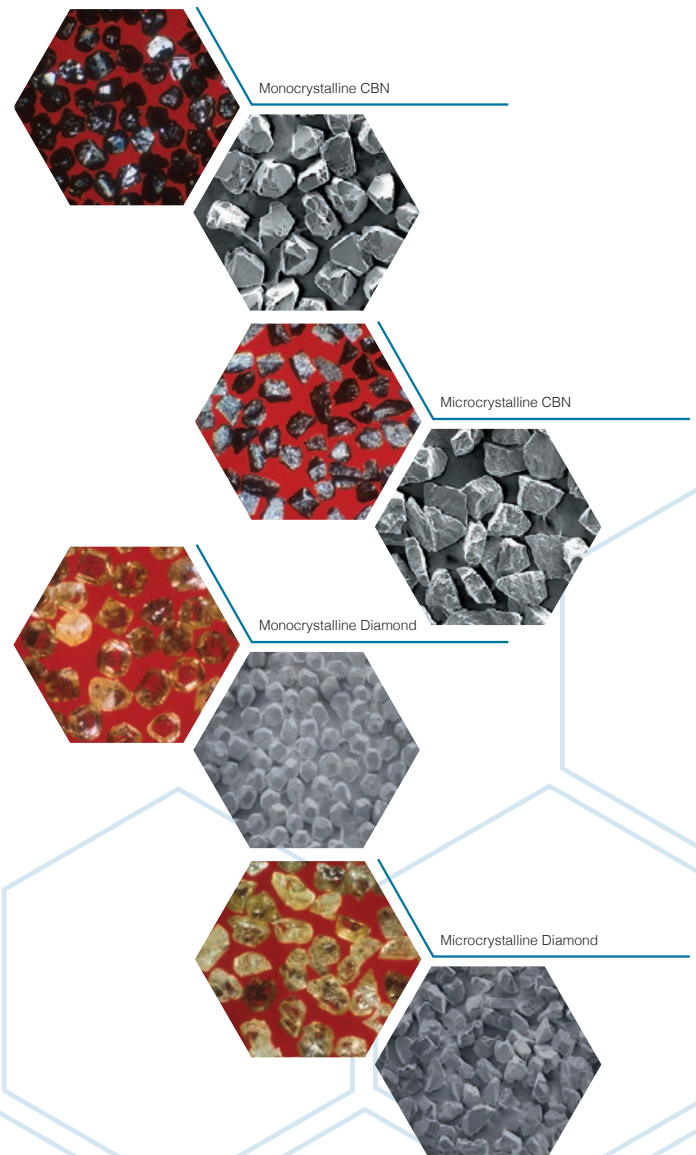
CBN and Diamond are the two hardest materials known to man. They are approximately twice as hard as aluminium oxide and take many times longer to develop a wear flat. They also have self sharpening properties, thus reducing the risk of crystal pullout unlike conventional abrasives.

Thermal Conductivity

Although Diamond is harder than CBN, the former breaks down excessively at high temperatures and when grinding ferrous metals. CBN has a high thermal stability and will resist chemical attack from iron, nickel and cobalt at high temperatures. The efficient chip production gives a low thermal input which is enhanced by CBN's high thermal conductivity (approximately five times that of copper) resulting in a much cooler grinding action compared to Aluminium Oxide.

Crystal Types

There are numerous types of CBN and Diamond available from various manufacturers. Most commonly used is the monocrystalline type of crystal which breaks when under high grinding pressure exposing new grinding edges. The other type of crystal is microcrystalline. This allows sub-micron sized particles to chip off each crystal. These basic types of crystal have derivations and coatings that have been developed over many years to enhance and improve the crystal foundation, durability, sharpness, life and other application driven advantages.



Bond Systems

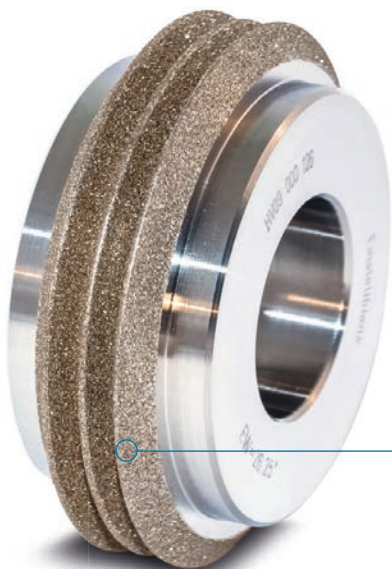
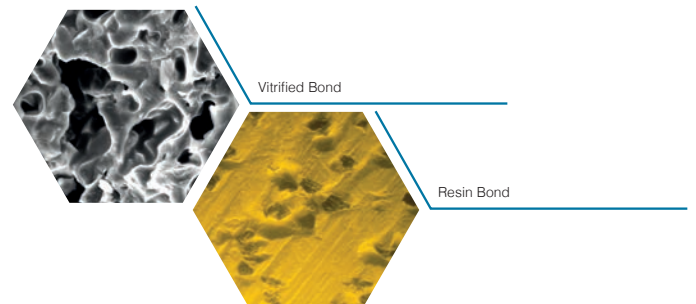
Vitrified Bond System

Vitrified is the most recently developed bond and has some very specific advantages for internal, external, centreless, surface, creepfeed, disc or any grinding application where high precision is required. The easily adaptable structure of the grit bond matrix usually allows truing and dressing in one operation.

Vitrified bondings are basically composed of glass. The bondings are mixed in powdered form along with the CBN or Diamond abrasive. Each component of the mix is precisely determined by the required characteristics of the finished wheel and are tightly controlled in the process. The resulting bond is tough and wear resistant, which makes vitrified bonded wheels ideal for extended wheel life and form holding.

One of the unique properties of vitrified bonds is porosity and the ability to “self-dress”. The porosity of a vitrified wheel provides better flow of coolant into the grind zone and improved clearance of chips. This allows a vitrified wheel to cut considerably faster than other non-porous bond systems under the same grinding loads. The porous structure and brittle nature of vitrified bondings also eliminate the need for stick dressing in most applications.

While the wheel is dressed with a rotary Diamond, small micro fractures are introduced into the bond posts near the surface of the wheel. When the wheel begins to grind the first part, the chips that are produced easily clear away the top layer of bonding, which exposes the sharp abrasive particles beneath. This is not possible with resin or metal bonded wheels. This characteristic of vitrified bonded wheels makes them ideal for high-production CNC grinding applications where operator intervention is kept to a minimum.



Electroplated (Nickel Bond)

The Electroplated product has a single layer of the superabrasive crystals which are encapsulated by a layer of nickel plating onto a steel core. Plated products are relatively inexpensive in comparison to the other types of bond systems, but their single layer of abrasive results in a shorter life. The grinding action of a plated wheel is very open and aggressive making fast metal removal one of its advantages.

Once worn out they can be stripped and replated as long as the steel core has not been damaged. Plated wheels are not normally dressed but can be cleaned with a brush or abrasive stick if loading takes place. These products are economic for short runs and ideal for complex forms such as gears and some aerospace components. Plated Diamond wheels are the only product that will effectively cut plastic and fibreglass without loading or glazing.

Bond Systems

Resin Bonds

This bond uses phenolic or polyamide resins to hold the CBN or Diamond in place. Wheels manufactured by this method are reasonably free cutting although they may have to be kept open by the use of an aluminium oxide stick, which periodically has to be pushed into the rotating wheel. These wheels are extremely popular for tool and cutter manufacturing and re-grinding. They can operate either with or without coolant, as it is possible to add lubricants to the resin bond formulation.

Variations in the bond hardness can also be achieved by use of differing bonds. For optimum performance this product should be engineered to suit the individual application. Resin wheels have to be trued and then have a separate dressing operation carried out, often by hand.

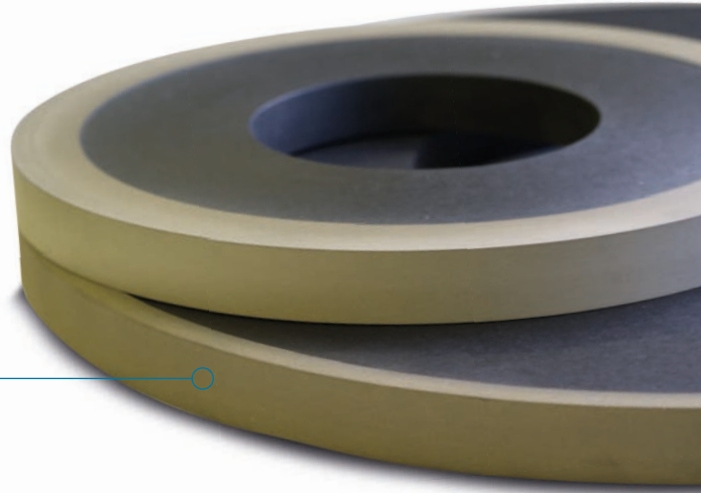
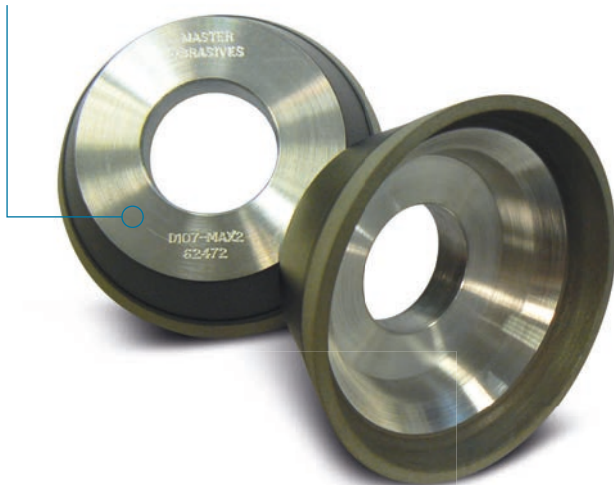
MAX2 Grinding Wheels

Master Abrasives MAX2 grinding wheels provide the ultimate solution for high performance in the dry conditions associated with manual re-sharpening of cutting tools.

Applications:

- Re-grinding flutes
- OD relief
- Primary & secondary relief
- Point sharpening
- Applications in steel or carbide
- Special resin bond
- Available in both CBN & Diamond

MAX2 is a new resin bond for use in the tool and cutter grinding market. Utilising the latest technology in micro-porosity and micro-lubrication, the cool cutting action and long lifetime make MAX2 a leading alternative to other manufacturer's wheels, offering excellent performance and value for money.



Resin bonds for grinding thermally applied wear-resistant coatings

The increased utilisation of thermally applied coatings (e.g. HVOF, plasma spray, etc.) which are very tough and wear resistant has lead Master to introduce a specific range of resin bonded Diamond wheels to meet the grinding requirements.

Stripping Wheel

Coarse Diamond grit wheel designed to cope with the demands of removing an old coating and grinding the softer base substrate. Micro-lubrication and micro-porosity bond technology is utilised to offer fastest possible stock removal rates, without excessive wheel wear when grinding the softer base substrate.

Combination Wheel

All round specification designed to strip off the old coating and grind the full range of new thermally applied coatings. Medium sized Diamond grit gives a good commercially ground finish.

Finishing Wheel

Dedicated wheel designed primarily for grinding just the thermally applied coating. Fine to medium Diamond grit sizes give a very good surface finish.

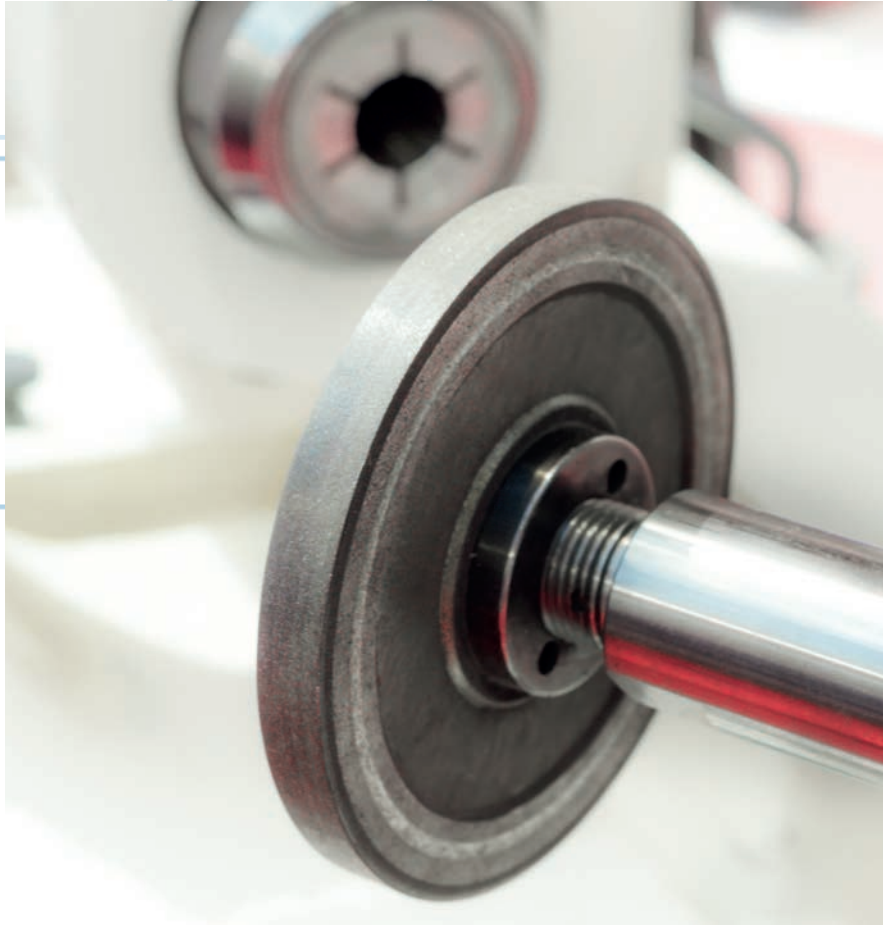
All our wheels are available on either Aluminium or black Bakelite bodies.

Bond Systems

Metal Bonds

Metal bonds are extremely dense and much harder than resin bonded wheels. These wheels grind much slower and generate much more heat, hence they would normally be used under flood coolant conditions. Due to their inherent hardness they do retain their shape and size under extreme conditions. However, the bond is not very free cutting and can be difficult to true and dress.

The largest application area for this bond system is in the grinding of non-metallic materials such as glass, quartz, stone etc. The construction industry in general is one of the largest market sectors utilising metal bonded products.



Bond Types Summary & Comparison

Vitrified (V)	Resinoid (R)	Metallic (M)	Electroplated (E)
<p>A very free cutting bond which should be used with coolant and stays sharp with controlled porosity.</p> <p>Very good grit retention due to chemical bond posts which gives longer wheel life, widely utilised in production applications due to the ability to true and dress in one single application with a rotary Diamond dressing tool.</p>	<p>Can be used with or without coolant. The grit is mechanically held, so full utilisation of the grit is not possible. Wheels need to be trued and then dressed separately with an Aluminium Oxide dressing stick.</p>	<p>Good grit retention for longer wheel life. Tend to be dull when applied to difficult materials. The grit is mechanically held, so full utilisation of the grit is not possible.</p> <p>Difficult to true and dress. Mostly for glass or easy to grind brittle material.</p>	<p>Complex form wheel with shaped metal core. The single layer of grit is held in place by nickel. Bases can be replated when the grit is worn so can be very cost-effective. The grit is mechanically held, so full utilisation of the grit is not possible.</p> <p>Very rough and very precise application (gear etc.) Good grinding efficiency.</p>

Superabrasive Particle Sizes

Grit Sizes

FEPA	MICRON	US MESH
427		40/50
356		45/50
301		50/60
252		60/80
213		70/80
181		80/100
151		100/120
126		120/140
107		140/170
91		170/200
76		200/230
64		230/270
54		270/325
46		325/400
35	30/40	400/500
30	20/40	500
25	20/30	600
20	15/25	
15	10/20	800
12	8/16	1000

Coarse

fine

Concentration

The concentration can be defined as the relative amount of superabrasives contained in the wheel. The selection of the most suitable concentration is essentially determined by the size of the contact surface between the grinding wheel and workpiece.

Basic Guidelines:

Small contact surface and coarse grit size:
HIGH CONCENTRATION

Large contact surface and fine grit:
LOW CONCENTRATION

Concentration	25	50	75	100	125	150	200
Volume % of Grain	6.25	12.5	18.75	25	31.25	37.5	50
Cts/cm ³	1.1	2.2	3.3	4.4	5.5	6.6	8.8

Specification Breakdown

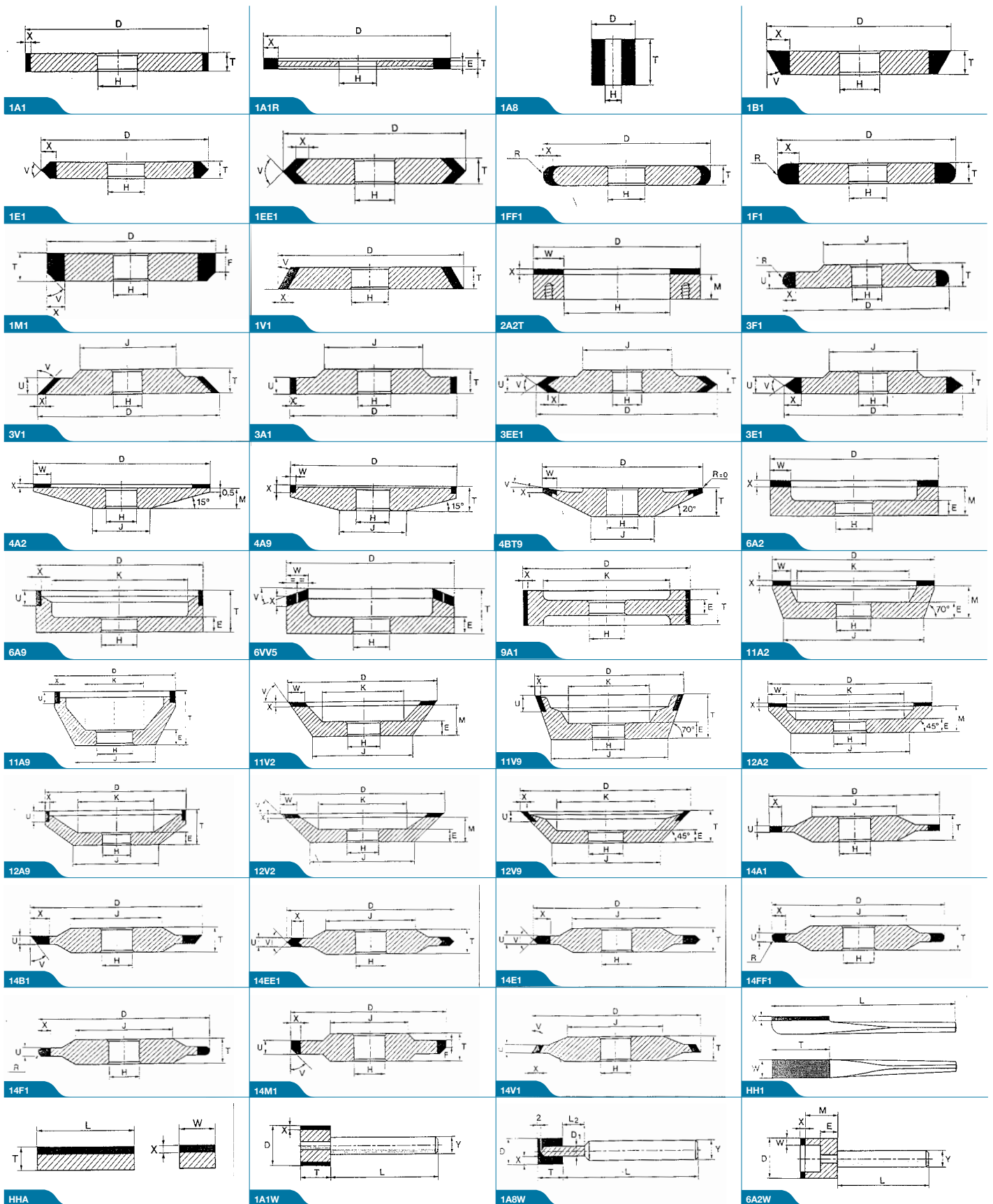
Master Bonds (excluding vitrified)

D	Grit type D – Diamond Grit B – Cubic Boron Nitride (CBN) Grit
126	Micron grit size - the size of the superabrasive particles in line with the FEPA standard
100	Concentration of the wheel
MAR	Bond System - MAR - Master Resin MAM - Master Metal MAE - Master Electroplated MAX - Master special resin bond
14	Bond formulation (proprietary)

Master Bonds - Vitrified

CBN	Grit type - D – Diamond Grit CBN – Cubic Boron Nitride (CBN) Grit
325	Mesh size in US Mesh designation
100	Concentration of the wheel
L	Density/Hardness
V	Bond system - V - Designates Vitrified Bond

Superabrasive Wheel Shape Drawings



Dressing Systems

Preparation

The preparation of any grinding wheel to ensure optimum cutting efficiency is important to the success of the process. It is critical in the case of vitrified CBN and Diamond wheels, often making the difference between success and failure. The selection of the correct dressing tool and the setting of the appropriate parameters are very important. A rotary system is always recommended as being the most efficient way of truing and dressing vitrified products, which can be performed in one operation.

Dressing Ratio

The ratio between the dressing tool surface speed and the grinding wheel surface speed is important and this, in conjunction with the rotational direction of the two wheels (at the point of contact), will have a significant effect on the cutting ability, especially of a vitrified bonded grinding wheel and surface finish of the ground component. Dressing unidirectionally (dressing wheel and grinding wheel are going in the same direction at the point of contact) results in an open, free cutting wheel.

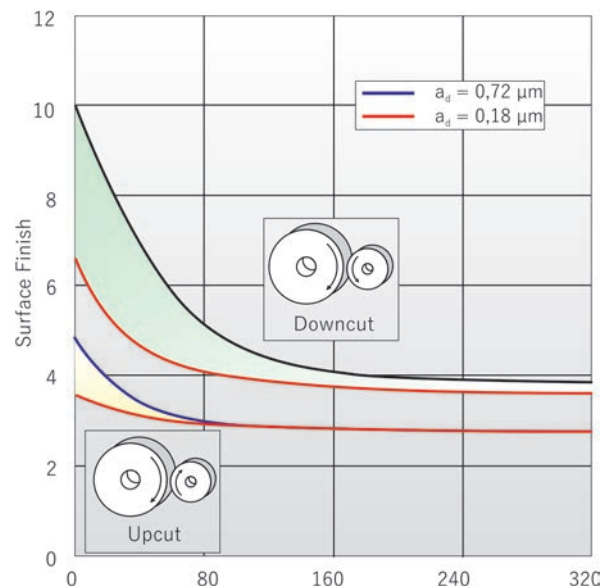
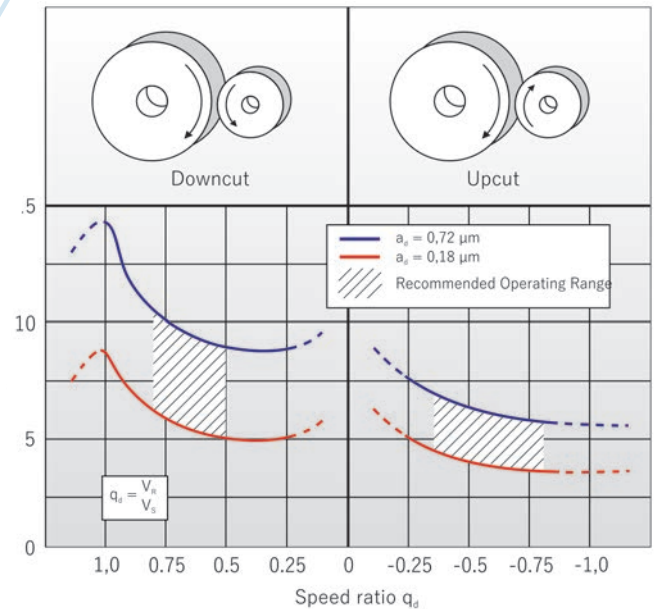
Dressing Traverse Rate

The final consideration is the speed at which the dressing tool travels across the face of the wheel. This speed has a direct influence on how free cutting the wheel becomes. The faster the traverse rate the more open the wheel. The Master technical team is always available to work with you on the establishment and setting of the correct parameters to optimise your individual process. The philosophy of offering complete solutions is continued with the following types of dressing products being available to ensure your satisfaction.

Dressing Infeed

To obtain the best economics from a vitrified CBN or Diamond wheel, the amount of grinding wheel removed by the dressing tool upon the occasion of each dress should be minimal and restricted to a value that restores the wheel's cutting ability (typically 0.002mm).

The radial infeed (μm) of the rotary Diamond dresser per grinding wheel revolution is chosen as the characteristic value for the infeed. High infeed, especially in downcut dressing, results in coarser surface finish. Recommended infeeds: 0.25 – 0.5 μm / grinding wheel revolution. To re-establish grinding wheel profile, the infeed should be less than 0.03mm.



Dressing Spindles

High Frequency Dressing Systems

These are the most efficient systems for dressing vitrified superabrasive wheels. The first of these has a variable speed up to a maximum of 60,000rpm with constant power and axial stability. It is of rigid construction and manufactured with three special bearings for extreme stability and control.

The spindle illustrated is shown with a converter and a rotary dressing cup. The optional touch dressing facility allows for thermal displacement to ensure the best possible overall control of the dressing process.



Pneumatic Dressing System

This system is particularly useful when there are budget restrictions which prevent the use of more sophisticated High Frequency Systems. The dresser is of a stable construction and is fitted with high-quality ball bearings. The average speed is around 15,000rpm, dependent on the air quality and pressure.



Dressing Tools

Diamond Dressing Cups

This type of dressing tool is one of the most popular for the rotary dressing of small internal CBN grinding wheels. There are basically two differing bond types available.

The electroplated type uses the plating process as described earlier to deposit a single layer of Diamond onto the steel body. This type is less expensive and very free cutting but wears relatively quickly so requires changing on a regular basis.

The metal bonded type is much more durable and provides longer life. The cups are customised high precision products. The tools offer outstanding characteristics, producing a safe and controlled dressing operation with significantly improved economics.



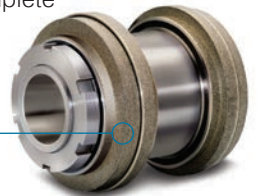
Diamond Dressing Discs

Diamond discs are becoming more popular especially with the development of CNC interpolation of forms. Here again the various bond systems can be utilised with metal bonding being the most popular. Once again Master is able to offer the complete range, including the latest technology of vitrified and hybrid bonded discs, to ensure complete process optimisation.



Diamond Form Roller Dressers

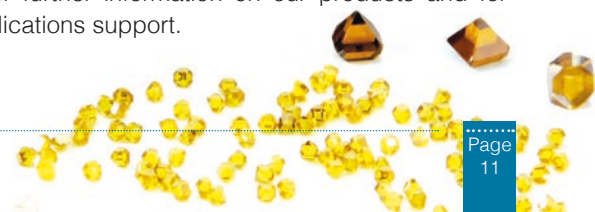
To ensure Master is able to offer the complete package, we can also supply reverse, random, or hand set precision Diamond roller dressers for the forming and dressing of accurate profiles.



General Diamond Tooling

To complete our range of dressing tools, Master also offers high-quality and engineered single point and fliese type dressers. Master Abrasives offers the complete superabrasives package for industry.

Contact us for further information on our products and for technical applications support.





Aerospace

Tooling

Fabrication

Power
Generation

Medical

Heavy
Engineering

Automotive

Bearing

Oil & Gas

Woodwork

SOLUTIONS FOR INDUSTRY

For further information on Master products and services or technical applications support, please contact us

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