Company Profile

Originally founded in 1951, the Meister company quickly became a market leader in the manufacture of precision internal grinding wheels and spindle mounted abrasive products in ceramic bondings.

Meister is now an international manufacturer of high precision abrasive products for the automotive, fuel injection, bearing, tool and cutter, semi-conductor, and aerospace industries worldwide. Specialising in both internal and external grinding, Meister has a full range of products to suit the high demands of precision component manufacturing faced today.

Our renowned high standards for development and consistent quality control are as true today as they were in 1951. Working under the international system of quality management of ISO 9001-2000 we constantly strive for continuous improvements.

As one of the first companies to develop vitrified bondings for CBN and Diamond, our continual investment in research and development ensures that we remain at the forefront of abrasive technology.

In addition to our Swiss headquarters and manufacturing facility, we have established manufacturing divisions in both the UK and USA where the same rigorous standards apply.

The UK Division, Master Abrasives Ltd, has been established since 1967 and is based in Daventry, Northamptonshire, the heartland of England.

Meister Grinding Technologies was established in 1988 in Massachusetts to support the development of our growing customer base in the USA.

From our custom built manufacturing and distribution facility at North Kingstown, RI, we serve the North American market with high quality Superabrasive products.

The most recent development in the Meister Group is the establishment of Meister Abrasives in Milan, Italy. This sales arm of Meister will ensure the high standards of service for our Italian customers.

We believe that our customers deserve the best possible service. Consequently, we strive to provide the highest standards of customer service and applications engineering in the industry.

The service we offer

Precision

Specialising in vitrified products, Meister is capable of producing wheels from 1mm up to 700mm in diameter for both internal and external applications. Having established our reputation for precision and consistency in the fuel injection industry around the world, Meister has become a market leader in this field. An established customer base in various industries includes; manufacturers of fuel systems, bearings, transmissions, pumps, marine diesel engines, gas engines, car diesel engines, aero engines, electronic components, machine tools, tooling components and hydraulic components.

Development

We work closely with the machine tool manufacturers to develop wheels and grinding systems for specific purposes. Our research department then works with our internationally experienced applications engineers to determine and refine the right specification to achieve the objective. Thus drawing from 50 years of Meister's manufacturing experience in precision engineering of abrasive tooling.

Quality

Our quality control is exceptional and as a consequence, Meister is recognised for attention to detail and consistent production from wheel to wheel and batch to batch. These detailed controls over our processes ensure that all internal grinding wheels are controlled within 0.001gm irrespective of batch size. This degree of reliability enables machine tool manufacturers to be confident of the grinding system they are selling to the customer and ensures a consistent grinding process.

Bonding Technology

Vitrified bondings are recognised as the future of production grinding. The "in house" development of these bondings has long been a key factor in our success and we believe our bonding technology to be amongst the finest available. Optimal use of the superabrasive crystal can only be achieved if the bonding technology is also optimised. It is from this basis that the best grinding process economics can be achieved.

Customer Service

Our long tradition of consistent precision has helped us maintain our position as suppliers to some of the world's leading manufacturing companies. A quality product is not enough to guarantee success though, as customers' needs differ. For this reason we ensure a high level of customer contact. Good communications with our customers are seen as a fundamental requirement in Meister. Our customer service team constantly seek to ensure that we meet (and exceed) the expectations of our customers. We listen and consequently, strive to provide the highest standards of customer service in the industry. We appreciate that you have a choice and we want you to make Swiss Master Products your quality decision.

Characteristics of Superabrasives

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 non-ferrous 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.

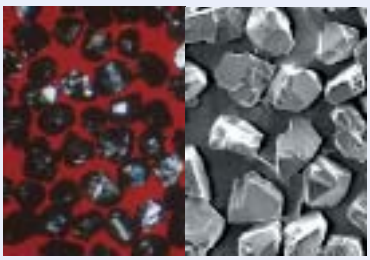
Crystal Types

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.

Fig 1

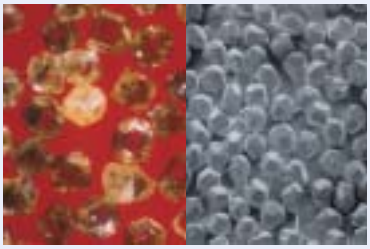


Monocrystalline CBN

Fig 2

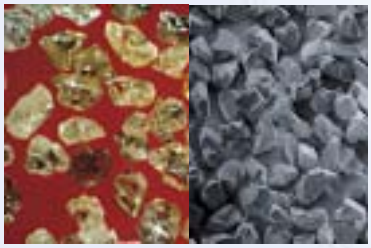
Microcrystalline CBN

Fig 3



Monocrystalline Diamond

Fig 4



Microcrystalline Diamond

Characteristics of Superabrasives (cont'd)

Crystal Shape

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.

Fig 5

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.

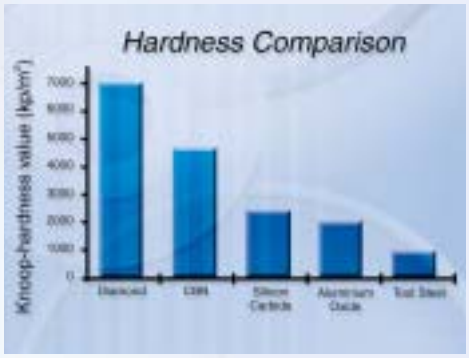


Fig 6

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 5 times that of copper) resulting in a much cooler grinding action compared to Aluminium Oxide.

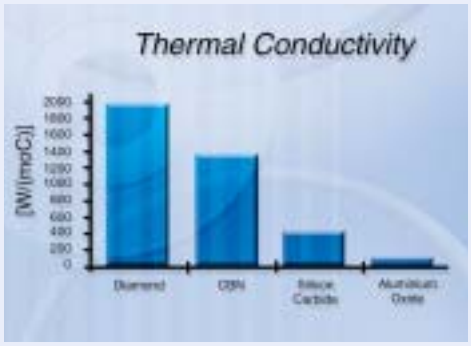


Fig 7

Bond Systems

There are four main bond systems used with either CBN or Diamond superabrasive material.

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.

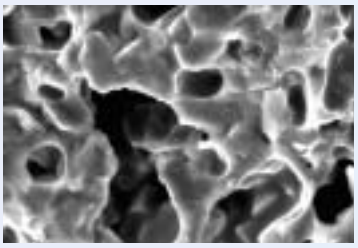
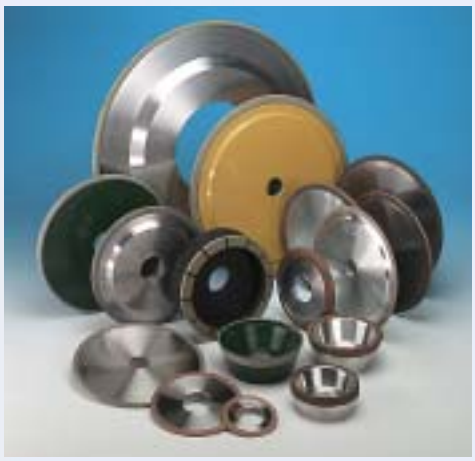


Fig 8 Vitrified Bond System

Fig 9 Resin Bond System

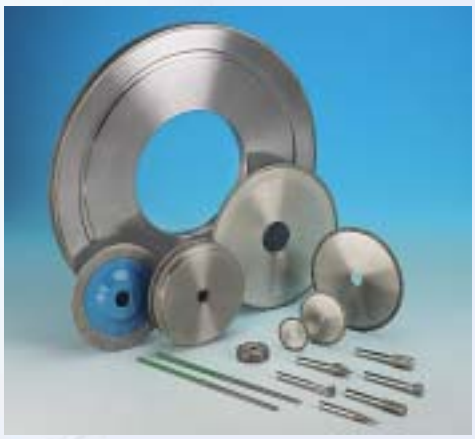
Bond Systems (cont'd)

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.

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 re-plated 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.

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.

Benefits of Vitrified Superabrasive Products

Significantly reduced wheel wear

Due to the shape and hardness of the crystal, a large grinding ratio is possible under the right conditions.

The grinding or G ratio is the volume of material removed in relation to the volume of wheel wear.

The G ratio for superabrasives can be many times that of conventional abrasive wheels resulting in fewer wheel changes. Less frequent dressing cycles are required and better form holding is possible.

The G ratio for superabrasives can be enhanced still further by relatively high peripheral wheel speeds illustrated by the graph shown *(fig 10)*.

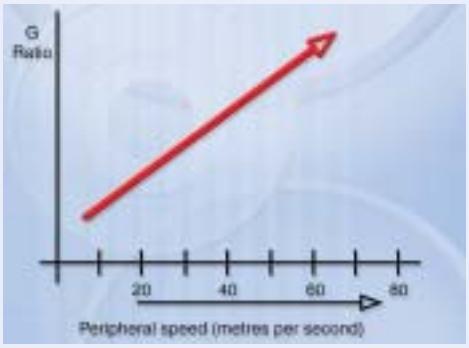


Fig 10

Improved productivity

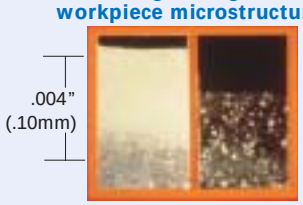
Superabrasives stay sharp much longer than conventional abrasives, especially at higher stock removal rates. The vitrified bond enhances the superabrasive performance through faster infeeds, large dressing intervals, minimal dressing amounts and consequently reduced cycle times.

Consistent quality of components

Superabrasives can achieve improvements in size, geometry and surface finish due to the efficient cutting and low wear rates. Subsequently, control over component quality improves, resulting in fewer rejects and reduced inspection costs.

The thermal properties of superabrasives prevent metallurgical damage to the workpiece *(fig 11)*. The heat absorbed by the crystal while grinding, results in residual compressive stress to the workpiece surface instead of tensile stress as with conventional and even sintered abrasives. Cracks on the ground surface or sub-surface will thus be avoided.

Effect of grinding on workpiece microstructure



Aluminum Oxide BORAZON© CBN

Fig 11 *Supplied by GE Superabrasives*

Automated grinding

The full use of automated CNC machinery can be achieved with superabrasives. The unmanned operation of the grinding machine, due to fewer wheel changes and consistent quality, becomes possible.

Ability to machine "difficult to grind" materials

CBN's remarkable properties allow it to grind the hardest of ferrous alloys including nickel/chrome, sintered and high speed steels. However, it is also able to grind the relatively soft super alloys used in the aerospace industry as well as plasma metal sprays.

Diamond's properties allow it to grind extremely hard and brittle non-ferrous materials such as tungsten carbide, glass, ceramics, silicon carbide, PCD and PCBN materials. Using this crystal in a vitrified bond enhances these properties.

Reduction in total cost per piece

Overall grinding costs can be reduced by the high material removal rates and minimal wheel wear. Better quality and more consistent parts are produced faster and more efficiently thus leading to reduced unit cost.

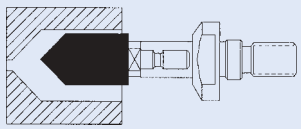
Governing factors for successful application of Vitrified Superabrasive Wheels

The following factors should be taken into account when assessing the application of Swiss Master Vit CBN or Diamond grinding wheels.

The Component

- Material type and constituents.
- Material hardness should be well controlled within the tolerance band.
- Stock removal should not be excessive and should be evenly distributed for optimum wheel performance.
- Pre-grind controls where possible, should be tight enough to ensure consistent component conditions.

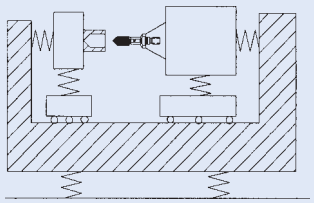
Component _____ *Fig 12*



The Machine Conditions

- Rigid machine tool design and construction.
- Accurately controlled feed systems.
- Grinding spindle should be rigid with sufficient number of bearings. Sufficient speed and power are important.
- Rigidity should be followed right through to the wheel. When internal grinding, the use of Tungsten Carbide or Heavy Metal quills engineered with a precise location for the wheel should be used whenever possible.

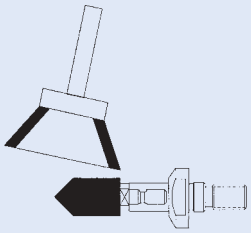
Machine Conditions _____ *Fig 13*



The Dressing Facility

- Rotary dressing should be utilised where possible with high frequency, hydraulic, or stable pneumatic dressers in conjunction with adequate bearings.
- Preferably a metal bonded, vitrified, or electroplated diamond cup or disc of larger grit size than used in the wheel.
- Precise control over dressing infeed of 0.001-0.005 mm (0.00004-0.0002 in).
- Initial dressing of the wheel is critical in preparation for the grinding operation.

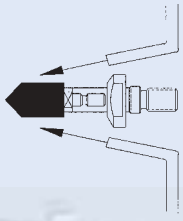
Dressing Facility _____ *Fig 14*



The Coolant Supply

- The system and nozzle design should ensure optimal delivery of the coolant to the grinding interface. “Good housekeeping” should be employed to ensure maximum efficiency of the system.
- The choice of oils, water-solubles, synthetics, or semi-synthetics must be carefully matched to the particular application.
- The system should have sufficient pressure and flow rate to ideally match the speed of the wheel, especially in creepfeed applications.
- Nozzles should be precisely positioned and maintained to direct the coolant to the point of contact in the grind zone.
- An adequately sized and clean filtration system is recommended.

Coolant Supply _____ *Fig 15*



Typical applications for Vitrified Superabrasive Grinding Wheels

The rapid development of production engineering techniques in the automotive, aerospace, tool & cutter, bearing and semi-conductor industries require improved quality and consistency at high production rates. Component workpieces are being manufactured to increasingly tighter geometric and surface finish tolerances. The more precision that is required in the finishing process, the more important grinding is becoming as a replacement to traditional machining methods, such as turning, milling and broaching. Vitrified bonded CBN and Diamond wheels offer the best solution to these conditions especially where advanced machine tool technology is applied. Vitrified superabrasive wheels can be put to effective and economic use on numerous applications, some of which were previously associated with other bonding methods. The following examples illustrate the primary range of applications:

Internal Grinding

Large volume and batch production of precision parts that require close control of geometry and surface finish as well as size. Component examples: bearings, fuel injection nozzles and fuel pump parts, hydraulic cylinders, compressor components, gears, valve lifters and other automotive components such as constant velocity joints.

Surface Grinding

Profile grinding and creep feed operations where consistent dimensional and geometric tolerances are required. Applications include face grinding of injector bodies, valve lifters and rollers. Also double disc grinding of flat components such as bearing rings and back-grinding of semi-conductor wafers.

Cylindrical Grinding

Form, centreless and OD grinding operations of ferrous and non-ferrous components requiring close dimensional accuracy and a good surface finish.

Typical applications for Vitrified Superabrasive Grinding Wheels (cont'd)

Tool & Cutter Grinding

High volume production and batch grinding of HSS, Carbide, PCD and PCBN tools where close tolerance, good form-holding, minimal surface damage and high removal rates are required.

Jig Grinding

The new range of jig grinding machines with flood coolant facility provides for the use of vitrified CBN and Diamond. Excellent results can be obtained in this field, particularly with the use of tungsten carbide shanks.

Superfinishing & Honing

Finishing of bearing ball races where surface finish requirements are extremely high and uniform results between components are important. Honing of automotive parts. Superfinishing of spherical and cylindrical components in the bearing industry and production of artificial joints in the orthopaedic field.

Grinding Quills

Meister recognises that not only is it important to formulate the correct grinding wheel specification and dressing tool combination, but that the method and design of the wheel mounting is just as important. In the field of internal grinding it is critical.

For this reason, Meister engineers take time to consider and where necessary, re-design the quill mountings to obtain the optimum performance and quality from the process. In many cases for internal grinding, an accurate thread mounting system is designed to provide ultimate rigidity, in addition to ease of mounting and accuracy when changing a wheel. A typical system is found in *(fig 16)*.

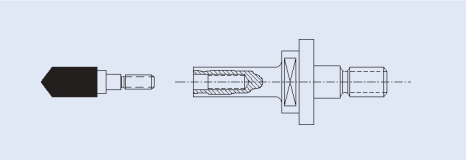
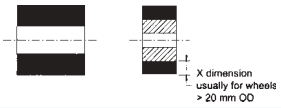
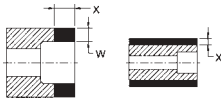
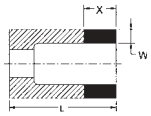
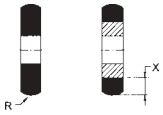
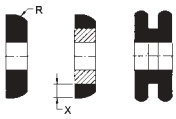
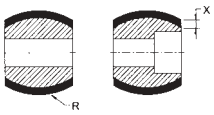
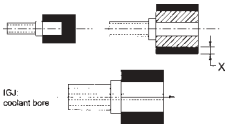
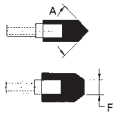
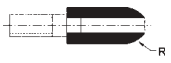
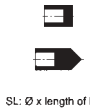
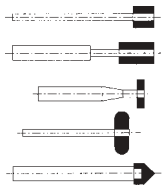


Fig 16

Quill material is also an important factor in design of the quill. Rigidity in the grinding of very high precision small bores and seats is impossible to achieve without the use of a solid tungsten carbide quill. Meister tungsten carbide quills are manufactured to the highest possible standard. All have threads that are precisely machined into the carbide, (Meister does not use steel inserts which compromise the benefits of carbide).

Alternative materials can be used as the quill sizes become larger. Alloys generically known as "heavy metals" have good mechanical and vibration damping characteristics and for the less critical and much larger internal applications, a variety of steels in both the treated and un-treated condition are also offered. A selection of tungsten carbide quills are shown on this page.

Shape codes and applications for Swiss Master Internal Grinding Wheels

Code	Description	Wheel Type	Applications
IS	cylindrical shapes		Most common shape for the majority of applications on internal and cylindrical grinders for grinding ferrous and non-ferrous materials.
ISA	recessed cylindrical shape		As above if clamping screw must not protrude.
ISAT	cylindrical shape with deep recess, L (recess) > .5L		Special cup wheels for internal facing of automotive parts, gears, and fuel injection components.
ISR	cylindrical wheel with radius		Special preshaped wheels for grinding steel and ceramic ball tracks on outer bearing races.
IS1R, IS2R	cylindrical wheels with single or double radius		As above, but for grinding radial contact or double ball track bearing rings.
ISRT, ISART	radiused wheel		Special shape for ID grinding of cages for bell components and constant velocity joints.
IG, IGJ	cylindrical wheel mounted on thread shank		Carefully mounted cylindrical wheels on threaded shanks for grinding injector bores, valves, inner bearing rings, automotive components and fuel pump parts.
IGA, IGF	cylindrical wheel with angle mounted on thread shank		As above for injector and valve seats
IGR	radiused wheel mounted on thread shank		Special wheels for inner and outer races of CV joint bell components.
ISL, IASL	small high precision cylindrical wheels for direct gluing onto quill		Carefully manufactured cylindrical wheels for grinding very small bores and seats in injector parts, valves, inner bearing rings, automotive components and fuel pump parts.
I, IR, IA	small wheels mounted on plain or recessed shanks		Used for small diameter bore grinding on cylindrical and internal grinders. A small wheel diameter typically necessitates this design. Also available in limited standard sizes for jig grinding machines.

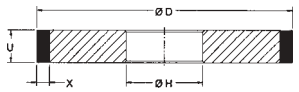
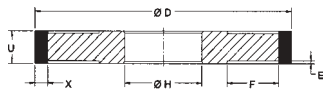
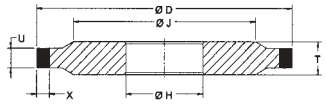
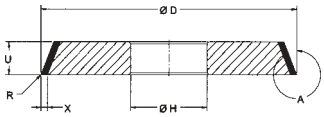
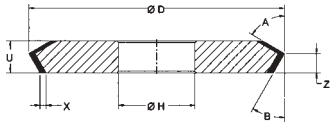
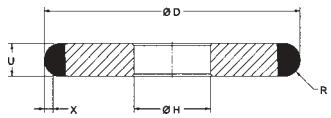
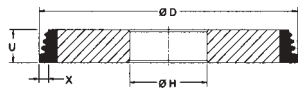
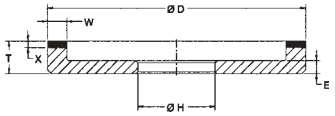
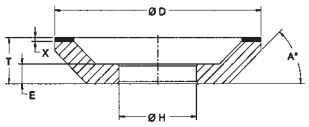
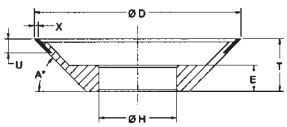
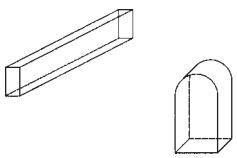
Typical materials ground with Swiss Master Internal Grinding Wheels

High Speed Steels
Tool Steels
Bearing Steels
Industrial Ceramics
Superalloys
Titanium Alloys
Carbides
Aluminium Alloys
Powdered Metals
Cermets

Typical machine tools that utilise Swiss Master Internal Grinding Wheels

UVA
Voumard
Nova
Tripet
Hauser
Overbeck
Ex-Cell-O
Seiko-Seiki
LMT
Studer
Heald
KAPP
Okuma
Reinecker
Toyo
Supfina
Thielenhaus
Cincinnati
Bryant
Moore
Weldon
Bahmüller

Shape codes and applications for Swiss Master External Grinding Wheels

Code	Description	Wheel Type	Applications
1A1	cylindrical Type-1 shapes		Most common shape for the majority of applications on external and cylindrical grinders for OD, surface, and creepfeed grinding of ferrous and non-ferrous materials.
1A1R	cylindrical shapes with side relief		As above, but used for deep cut applications such as creepfeed where side contact is not allowed or where maximum coolant access is required.
14A1	cylindrical shapes with tapered body		Typically used in slotting applications where the U dimension is not wide enough for adequate stiffness in the grinding wheel body.
1V1	cylindrical shapes with tapered grinding face		Used for applications such as angle-approach cylindrical grinding or tool & cutter form-grinding.
1EE1	cylindrical shapes with an included angle in the grinding face		Common shape used for angle-approach cylindrical and face grinding.
1F1	cylindrical shapes with a radius in the grinding face		Used for special form and profile grinding such as external ball-track grinding of bearing inner ring.
1S1	cylindrical shapes with a complex form in the grinding face		External form wheels for creepfeed grinding of special shapes such as dovetail forms in turbine blades.
6A2	cup shapes with straight sided base		Common shape used for surface grinding and finishing of automotive, aerospace and electronic components.
11A2, 12A2	cup shapes with angled sided base		As above, but with angled body to accommodate part and/or machine clearance requirements.
11V9, 12V9	cup shapes with angled sided base		Special shape used for tool & cutter applications.
FS, FSR	superfinishing stones		CBN or Diamond superfinishing stones for high-precision honing of surfaces in automotive, bearing, and orthopaedic components.

Typical materials ground with Swiss Master External Grinding Wheels

High Speed Steels
Bearing Steels
Tool Steels
Superalloys
Carbides
Powdered Metals
Industrial Ceramics
Titanium Alloys
Aluminium Alloys
Cermets
PCD and PCBN

Typical machine tools that utilise Swiss Master External Grinding Wheels

Studer
Blohm
Maegerle
Micron
Kellenberger
Tschudin
Walter
Jones & Shipman
Elb
Kapp
Weldon
Unison
ANCA
G & N
Stähli
EWAG
Coborn
Supfina
Thielenhaus

Dressing Systems

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 of the grinding wheel and surface finish of the ground component.

Dressing uni-directionally (dressing wheel and grinding wheel are going in the same direction at the point of contact) results in an open wheel.

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).

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 Meister 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:

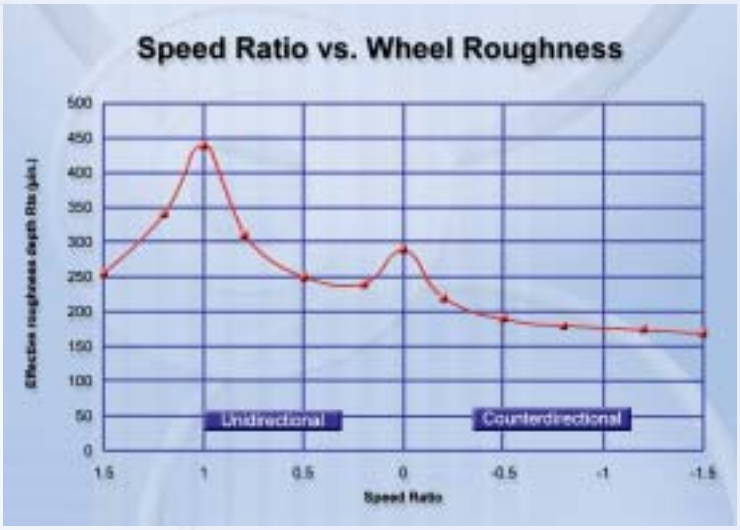


Fig 17

Dressing Spindles

This is an important area for consideration and Meister has various alternatives, some of which are mentioned here.

High Frequency Dressing Systems

These are the most efficient systems for dressing vitrified superabrasive wheels. The first of these has a maximum speed of 60,000rpm with constant power and axial stability. It is of rigid construction and manufactured with 3 special bearings for extreme stability and control. The spindle illustrated is shown with a converter and a rotary dressing cup.

AS40 HS Dressing System

Alternatively, the AS40 HS Dressing System is available. This small and compact electric spindle is ideal for dressing superabrasive internal grinding wheels where space is restricted.

Speed is variable up to 40,000rpm by using the accompanying frequency converter. 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 30,000rpm, dependent on the air quality and pressure.

Crush Dressing System

The FH1 Crush Dresser with precision ball bearings is protected by lubricated air. It is recommended for dressing/truing vitrified superabrasive and conventional wheels Ø 150-500mm on cylindrical and surface grinders.

Dressing Tools

Various factors like the type of application, machine tool, dressing spindle and grinding wheel specification will all have an influence on the type and specification of the dressing tool used. Meister Superabrasive Solutions includes a complete range of dressing products. Various styles in different bondings are available to assist in engineering the correct tool for your individual application.

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 three 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 latest development in this field, pioneered by Meister, is the **vitrified bonded** diamond cup. This utilises the latest vitrified bonding technology to produce a dressing tool that is as free cutting as electroplating but with the durability of the metal bonded cups.

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 Meister is able to offer the complete range, including the latest technology of vitrified bonded discs, to ensure complete process optimisation.

Diamond Form Roller Dressers

To ensure Meister 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, Meister also offers high quality and engineered single point and fliese type dressers.

Meister Specification Breakdown

CB5 - 170 - R - 9 - 260 - 150 - V55 - P5I - 31 - 4

CB5 **CBN and Diamond Types** The type of abrasive in the wheel is indicated by the designation CB (CBN) or D (Diamond) followed by a reference number. Several types of CBN and Diamond grains are available that span the range of shape, toughness and crystal structure. These are chosen by Meister to suit the particular application.

170 **Grit Size** A wide range of grit sizes are available and are designated in US-mesh. Very fine mesh sizes for superfinishing and electronics applications are also available, e.g. 600 – 50,000 mesh.

R **Grade** The hardness of the wheel is designated by the lettering system. This has a direct relationship with the amount of bonding in the wheel and is critical when setting a wheel specification.

9 **Structure** This number indicates the structure of the wheel and is closely linked with the hardness grade.

260 **Internal Code** This is an internal reference number.

150 **Concentration** The concentration indicates the CBN or Diamond abrasive content of a wheel. The Meister standards are directly related to the international system. For example, 100 concentration is equivalent to 4.4 carats of CBN or Diamond for each cm^3 of wheel volume

V55 **Bonding** We believe the bonding has a critical influence on a wheel's overall performance and we consequently have developed a range of very advanced vitrified bonding systems tailored for different applications. The bond is indicated by a reference number.

P5I **Induced Porosity**

31 - 4 **Internal Code**

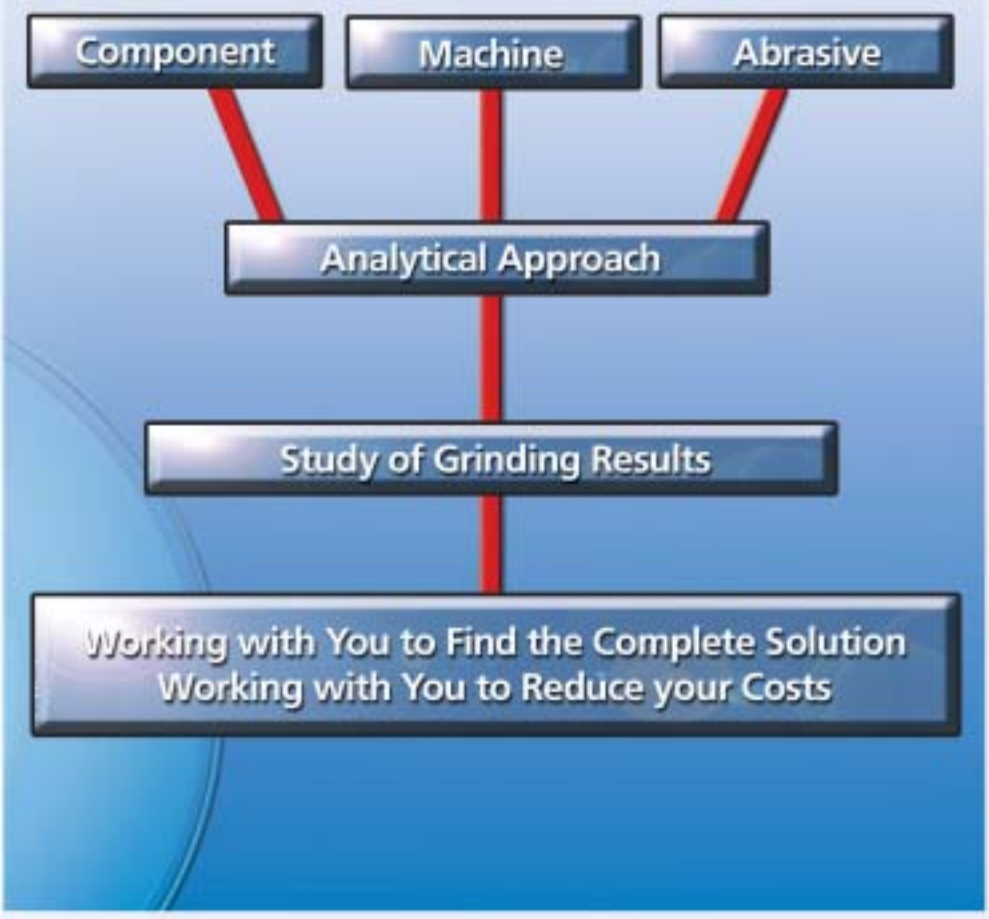
The Problem Solving Package

Meister provides both **Product** and **Process** development in order to optimise the performance of a grinding wheel in the grinding process.

Our precision grinding wheel manufacturing programme is supported by a systems approach. We believe that the customer should receive more than just a top quality wheel.

Therefore, we offer applications engineering support for any grinding problem, plus engineered ancillary products including precision grinding quills for internal applications and a full range of dressing equipment, including cups and discs for the optimum preparation of the grinding wheel. Consequently, the provision of top quality products and technical support from our experienced global applications engineering team, provides a formidable problem solving package. Make **Meister** products the natural first choice when you are looking for a complete grinding solution... .....**A quality decision**

The Meister Systems approach to Grinding Technology



Achieving the goal through attention to detail of product and process

Fax Back - Superabrasive Enquiry

SWITZERLAND + 41 52 304 2212 *UK* + 44 (0) 1327 871617
USA +1 401 294 7326 *ITALY* + 39 02 931 63 437

Date:	No. of pages:
Your Company Name: Address:	Contact Name: Title: Email: Phone/Fax No.:
Application Description:	Principal Objective:
Workpiece Description:	
Material:	Hardness:
Stock Removal:	(From Ø or R?)
Required Tolerances (finish, roundness, taper, etc.):	
Current Wheel Supplier:	
Type: Size:	Drwg available? (Y / N)
Current Specification:	
Price:	Normal Purchase Quantities:
Part Sketch	**Wheel Sketch**
Machine (Make/Model):	CNC? (Y / N) Condition of Machine: Fully Enclosed (Y / N)
Current Wheel Speed:	Max Spindle rpm:
Description of Quill (if applicable):	Coolant (type/mnfr):
Dressing Device Type: Speed Range (if rotary): Is the rotation direction reversible? (Y / N)	**Dressing Tool** Type: (disc, cup, singlepoint, form roller, ring) Size: Drwg available? (Y / N) Specification:
Current Dress Frequency:	Dress Depth: (From Ø or R?)
Current Wheel Life:	Current Tolerances Achieved:
Cycle Time (incl. load/unload):	Grind Time:

Notes

Vitrified CBN - Internal seat grinding

Benefits of Vitrified CBN vs Aluminium Oxide

- **Grinding Cycle time reduced by 50%.**
- **Dressing Frequency has decreased by a factor of 15.**
- **The number of components per wheel has increased by a factor of 60.**
- **A dramatic increase in productivity, the virtual elimination of defective products.**

Component: Fuel Injection Part

Material:	440c steel	**Hardness:**	56-60 HRC
Stock Removal:	0.100mm	**Surface Finish:**	0.2µmRa
Geometry Required:	Concentricity & Roundness		
Dressing Facility:	High Frequency (Rotary)	**Dressing Tool:**	Diamond Cup
Dressing Frequency:	1:15	**Dressing Infeed:**	0.005mm
Wheel Type:	IGA	**Wheel Size:**	Ø4.5 x 10mm

Applications 1

Vitrified CBN - Internal track grinding

Benefits of Vitrified CBN vs Aluminium Oxide

- **Grinding Cycle time reduced by 40%.**
- **Dressing Frequency has decreased by a factor of 45.**
- **The number of components per wheel has increased by a factor of 100.**
- **Improved productivity. Total automation of process possible.**

Component: Automotive Transmission Part

Material:	Induction hardened steel	**Hardness:**	58-62 HRC
Stock Removal:	0.200mm	**Surface Finish:**	0.8µmRa
Geometry Required:	PCD and pressure angle		
Dressing Facility:	High Frequency (Rotary)	**Dressing Tool:**	Diamond Cup
Dressing Frequency:	1:90 (Tracks)	**Dressing Infeed:**	0.015mm (x2)
Wheel Type:	IGR	**Wheel Size:**	Ø14.5 x 17mm

Vitrified CBN - Internal bore grinding

Benefits of Vitrified CBN vs Aluminium Oxide

- **Grinding Cycle time reduced by 20% due to reduced dress frequency.**
- **Dressing Frequency has decreased by a factor of 1000.**
- **Productivity has increased due to the elimination of frequent dress cycles.**
- **Consistent quality products are ensured.**

Component: Automotive Component (Hydraulic Tappet)

Material:	SAE 1010 steel	**Hardness:**	59-61 HRC
Stock Removal:	0.300mm (on dia)	**Surface Finish:**	0.4µmRa
Geometry Required:	Concentricity (0.002mm) Taper (0.003mm)		
Dressing Facility:	Pneumatic Rotary	**Dressing Tool:**	Diamond Cup
Dressing Frequency:	1:3000	**Dressing Infeed:**	0.005mm
Wheel Type:	IG	**Wheel Size:**	Ø13.1 x 8mm

Vitrified CBN - Internal bore grinding

Benefits of Vitrified CBN vs Aluminium Oxide

- **Grinding Cycle time reduced by 54%.**
- **Dressing Frequency has decreased by a factor of 40.**
- **The number of components per wheel has increased by a factor of 150.**
- **Productivity levels have increased.**
- **Consistent quality achieved.**
- **Cost savings made per component based on abrasive cost.**

Component: Aerospace Component

Material:	440C steel	**Hardness:**	58 HRC
Stock Removal:	0.200mm (on dia)	**Surface Finish:**	0.1µmRa
Geometry Required:	Roundness, Taper and Straightness all 0.003mm max		
Dressing Facility:	Fixed Tool	**Dressing Tool:**	Single Point
Dressing Frequency:	1:40	**Dressing Infeed:**	0.012mm
Wheel Type:	I (on carbide shank)	**Wheel Size:**	Ø7 x 15mm

Vitrified CBN - Internal bore grinding

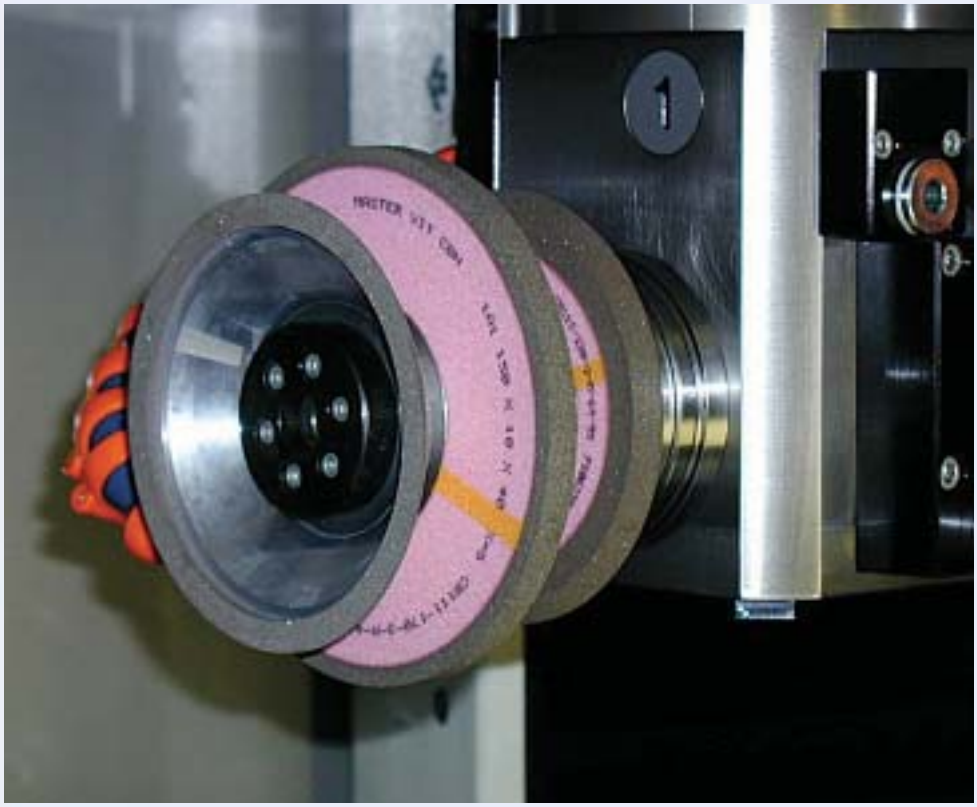
Benefits of Vitrified CBN vs Aluminium Oxide

- **Grinding Cycle time reduced by 35%.**
- **Dressing Frequency has decreased by a factor of 300.**
- **The number of components per wheel has increased by a factor of 100.**
- **Productivity levels have increased.**
- **Consistent quality achieved.**

Component: Ball Bearing Inner Ring

Material:	100 Cr.6 steel	**Hardness:**	60-62 HRC
Stock Removal:	0.400mm (on dia)	**Surface Finish:**	0.3µmRa
Geometry Required:	Taper and Roundness (0.001mm max)		
Dressing Facility:	High Frequency (Rotary)	**Dressing Tool:**	Diamond Cup
Dressing Frequency:	1:300	**Dressing Infeed:**	0.005mm
Wheel Type:	IS	**Wheel Size:**	13 x10mm

Vitrified CBN & Diamond - Tool and cutter grinding



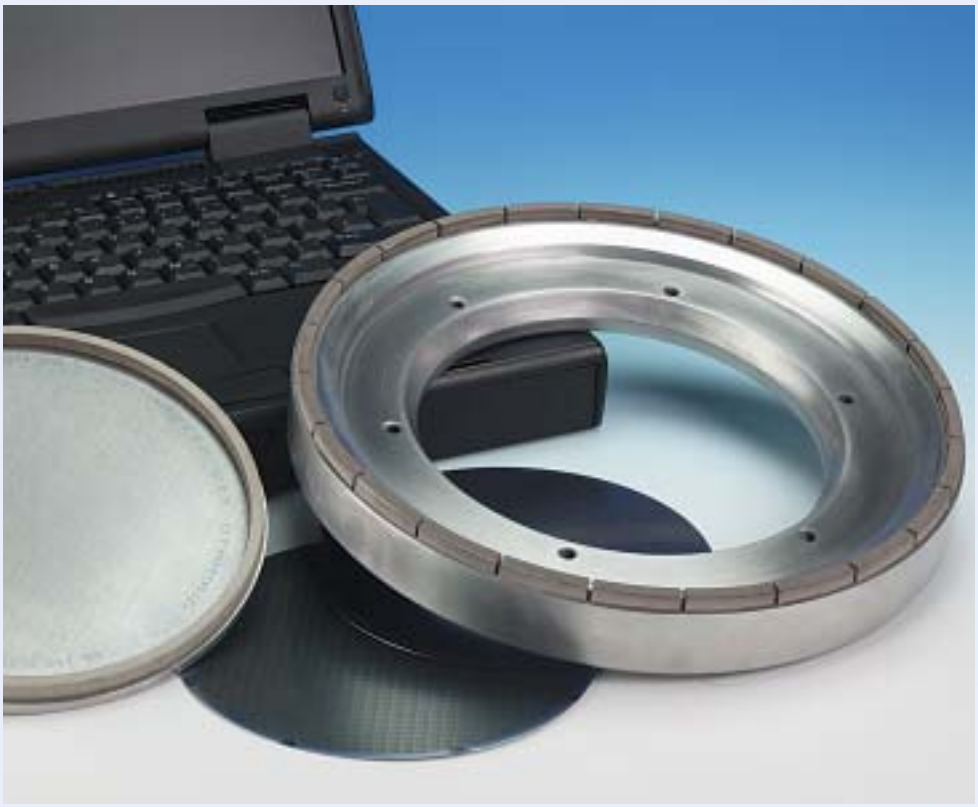
Benefits of Vitrified Diamond

- **Full utilisation of latest tool and cutter machine technology.**
- **Improved stock removal rates.**
- **On machine dressing.**
- **Free cutting wheels resulting in less metallurgical damage.**
- **Ability to fully automate process.**

Component: Milling Tool (Flute Grinding)

Material:	Solid Tungsten Carbide		
Stock Removal:	4.5mm deep x 75mm long	**Surface Finish:**	Visual
Geometry Required:	Size and form with no burn		
Dressing Facility:	Rotary	**Dressing Tool:**	Silicon Carbide Wheel
Dressing Frequency:	As required	**Dressing Infeed:**	As required
Wheel Type:	1A1	**Wheel Size:**	Ø125 x 12mm

Vitrified Diamond - Semi-conductor wafer grinding



Benefits of Vitrified Diamond

- **Increase in wheel life by factor of 10.**
- **Reduction in power required.**
- **Consistently low total thickness variation (TTV).**
- **Component strength reported as very good.**

Component: Silicon Wafer

Material:	Silicon		
Stock Removal:	0.035mm	**Surface Finish:**	0.013µmRa
Geometry Required:	TTV, bow, warp, strength all checked		
Dressing Facility:	Rotary	**Dressing Tool:**	Vitrified Diamond Wheel
Dressing Frequency:	Initial truing operation	**Dressing Infeed:**	0.100mm
Wheel Type:	6A9	**Wheel Size:**	Ø250mm

Vitrified Diamond - External grinding

Benefits of Vitrified Diamond

- **Improved wheel life.**
- **Reduction in cycle time.**
- **Ability to profile wheel on machine.**
- **Consistent part quality.**
- **Automation of process possible.**

Component: Die

Material:	Tungsten Carbide		
Stock Removal:	0.500mm	**Surface Finish:**	Visual
Geometry Required:	Maintenance of profile within tolerance		
Dressing Facility:	Rotary	**Dressing Tool:**	Rotary Disc (Metal Bonded)
Dressing Frequency:	As required	**Dressing Infeed:**	As required to re-profile
Wheel Type:	1A1	**Wheel Size:**	Ø300 x 15mm