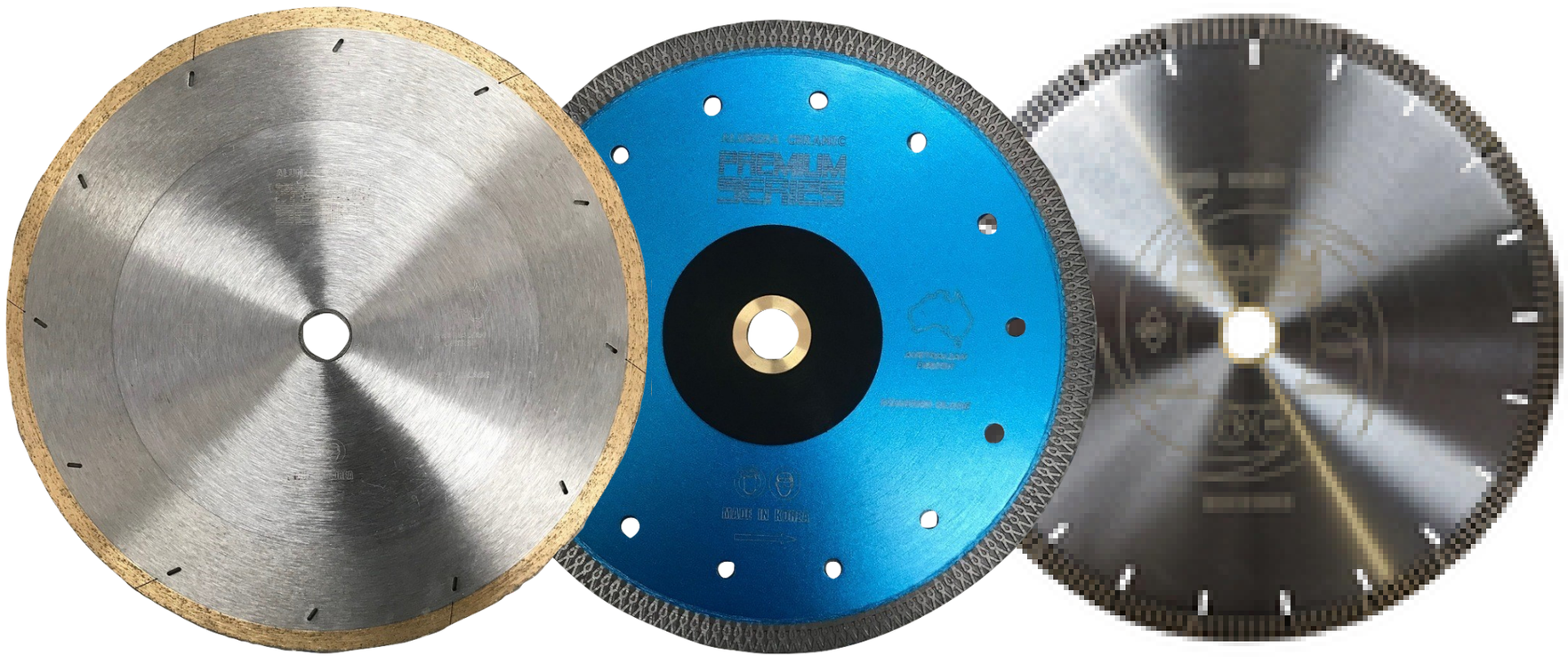
CUTTING ALUMINA CERAMIC:

THE ULTIMATE GUIDE



Learn how to cut alumina ceramic, silicon carbide, ZTA and other wear plate materials.
PLUS useful tips and tricks

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Contents

So you are cutting and you don't want to screw it up. It's okay, we've got you.

Cutting Alumina Ceramic, Silicon Carbide, ZTA and other wear plate materials can be tricky. Precision cutting can be difficult to achieve when the material is easily chipped or cracked whilst being cut.

Over the years, we have worked with our customers and our suppliers to create this guide of handy hints to help you achieve the perfect cut. We hope you find this book useful and answers some questions you may have had about wear plate materials.

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Chapter One: Factors to Consider

Advanced modern ceramics are known as very difficult-to-machine materials. The main factors are their hardness and susceptibility to chipping. But at the same time, ceramic components often need to meet high standards for dimensional accuracy and surface quality.

Over the years, we have worked with our customers and our diamond blade manufacturers to provide cutting solutions to the evolving wear plate industry. As the percentage of zirconium in alumina ceramic has increased, our diamond blades have changed to respond to our customers' demands.

To achieve maximum diamond blade life and overall performance you will need to account for:

- Material Hardness
- Material Density
- Cutting Technique
- Material Shape
- Cutting Speed
- Feed Rate
- Coolant
- Dressing
- Equipment Type/Condition
- Material Holding Method
- Operator Experience

Any change in the above variables can significantly impact the cutting results. The material being cut can vary in composition or density even when coming from the same supplier. A slight change in the coolant feed rate, its direction, feed speed, and even the way the material is held in place can make a difference.

When first cutting alumina ceramic, try using lower machine speeds and smaller cut depths as this will help keep the piece cool, reduce the potential of chipping, and lead to overall the better results. And always avoid physical shock to your work piece.

Material Hardness

As the percentage of zirconium in alumina ceramic has increased, our diamond blades have changed as well. If the bond matrix on your diamond blade is too soft for the material being cut, it will result in faster wear and shorter blade life. On the other hand, if the bond matrix is too hard, it will result in much slower cutting speeds as well as require constant dressing to expose the next diamond layer. Plan on a hardness of 900 to 1100 on the Vickers hardness test, but in the future hardness may even reach 1500.

If you are cutting alumina ceramic, it is generally recommended that you use a soft bond, thinner kerf (kerf is the width of the cut) diamond blades.

Material Density

The ever increasing variety of new generation, ultra hard, composite, engineered materials, often with highly metallic content, changes the way we cut with diamond blades. Each material has a different density, hardness and composition, so the diamond blades and cutting processes that have worked on one material may not work on another. Material being cut can vary in composition or density even when coming from same supplier.

Cutting Technique

The thicker the material you are cutting, the greater amount of coolant and water pressure is required, and the longer the cutting time. Multiple shallow cuts (step cuts) are better than one single deep cut. Cutting deep depths in a single pass can damage the diamond blade and stall the saw. Step cutting prolongs blade life, is safer and more accurate.

Material Shape

To obtain ideal results, select your diamond blade based on the unique differences and properties of each material, it's shape, size, diameter, hardness, and brittleness. Always cut the material so to minimize the cutting area.

Cutting Speed

Correct speed is one of the most critical factors in successful diamond tool usage. If the diamond blade rotates too slowly, it drags and creates heat. If it rotates too fast, friction and heat are generated. Heat is the worst enemy for alumina ceramic. Selecting the right RPM can be the most difficult aspect of cutting, as many machines do not have variable speeds. However, changing the blade diameter will adjust the "surface feet per minute" speed.

Alumina Ceramic diamond blades can be used either at low or high speeds, each with their own advantages and disadvantages. At very high speeds, diamonds may break (fracture), whereas at very low speeds, they may fall out. An optimum surface speed (RPM) must be selected to balance out the two disadvantages. Diamond blade life will usually increase at slower cutting speeds but the increase in labour costs and other overhead expenses will usually offset savings of diamond blades and other consumables.

If a diamond blade develops dark "burn" marks, the blade is being used too fast or the amount of pressure is too great. Reduce cutting speed or adjust pressure accordingly.

In Western Australia, electric motor variable speed drives are available from W.A. Rewinds in Osborne Park .

Feed Rate

The bulk of alumina ceramic is cut on computer/CNC controlled precision cutting equipment, so feed rate can often be controlled to a very accurate and constant speed. Experimentation is often needed to find the optimum speed, but it is always slow! Feed rates maybe as low as 500mm per hour.

Coolant

Heat will cause wear plate materials to crack, so more cooling is required when cutting compared to other hard materials. There is a large variety of coolants you can select, ranging from water, to water soluble coolants, to mineral oils. Coolant selection is determined by your specific application, and your wear plate supplier will often have recomendations. Make sure your coolant is not just sprayed on the blade, but directed to where the material is cut by the blade.

Some diamond tool manufacturers recommend the use of either:

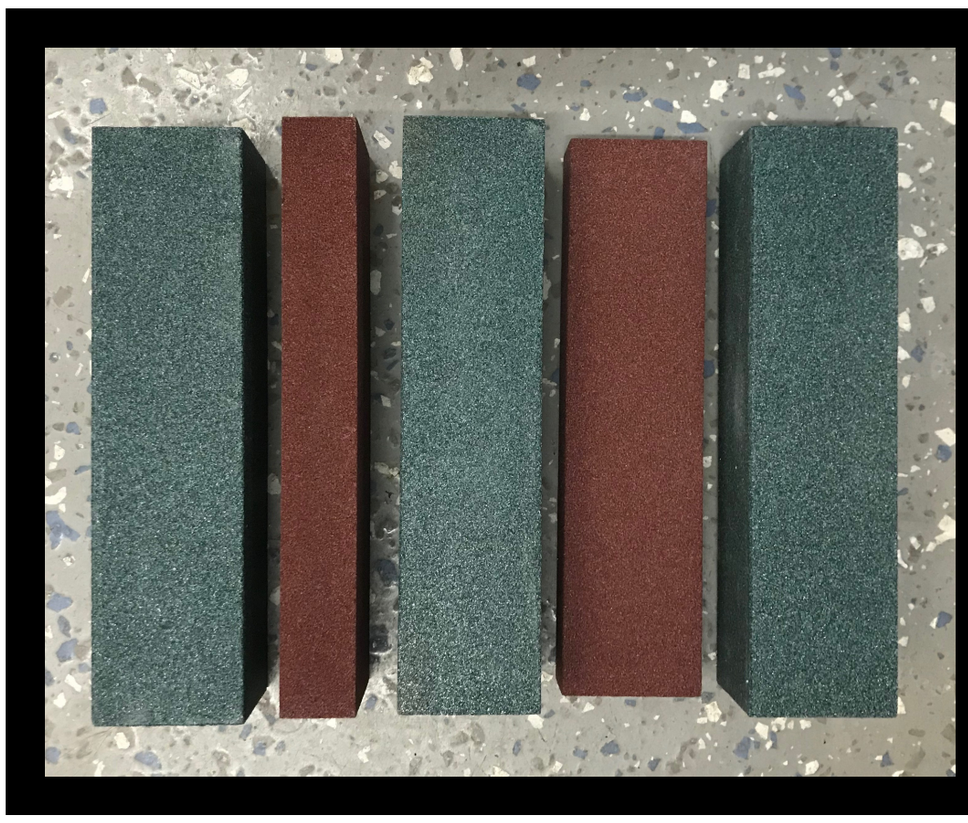
- water or detergent/water mix
- soluble oil (emulsions of oil in water). One disadvantage of soluble oils is their white, milky colour can obscure vision of the cutting zone.
- light weight mineral oil (although the storage, use and disposal of mineral oil can be more hazardous than the above options).

Water (often with detergent added if practicable) is an ideal organic coolant that does not leave the material feeling oily, greasy, or contaminated. Oily tiles can be harder to glue later in the process. The amount of coolant used should increase with the hardness of the material being cut. If you see sparks, there is insufficient coolant reaching the cutting zone, or it is ineffective. Use flexible coolant hoses and upgraded recirculation pumps to deliver the coolant to the cutting zone, and not just on to the blade.

Using the most effective coolant can allow higher blade and table speeds, greater depths of cut, increased blade life and a better surface finish.

Dressing

Because alumina ceramic will crack if it overheats, plenty of coolant is required. The extra coolant has a side effect of causing the blade to glaze over, keeping the diamonds below the bond surface. This reduces cutting effectiveness. Regular dressing of the blade will keep diamonds thoroughly exposed at all times. Dress a new diamond blade before usage, then frequently redress it while using it, as it will reduce chipping or cracking. Always use a recommended dressing stone, such as an 80 grit stones stocked by United Diamond Tools.



RED: 80 grit, 200mm x 25mm x 50mm

OR

GREEN: 80 grit, 200mm x 50mm x 47mm

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Equipment Type and Conditions

The equipment you will be using, as well as it's physical condition, will dictate the speed (RPM) and coolants you can use along with your diamond blades. The precision, accuracy, and repeatability of your equipment will also determine the tolerances you will be able to obtain. A rigid, true running spindle with good bearings is essential for precision cutting.

Entry level saws are usually single phase tile or brick saws, and mid range is a three phase block saws, as this motor is more powerful, reliable and efficient over single phase options. Both of these options will most probably need flexible coolant hoses added and recirculation pumps upgraded to provide enough coolant at the cutting zone. The ultimate saws are programmable bridge saws with CNC control.

Material Holding Method

The material must be held firmly for cutting. A work table that feed smoothly, without side play, is essential. Sometimes rubber mounting is necessary to remove vibration.

Operator Experience

Cutting speed and surface finish quality are often the most important considerations when cutting. A skilled operator can balance the life of the blades against their cutting rate, while maintaining surface finish quality.

Chapter Two: Evaluating Diamond Blade Performance

The performance of your diamond blade can be evaluated under various criteria. Your requirements dictate which of the criteria is most important.

Cutting Life

It is very difficult to estimate the life of diamond blade. It's longevity is affected by factors such as the application, bond type, blade manufacturer, and hardness and abrasiveness of the material being cut. Also, the following considerations play a major role in diamond blade life:

- RPM (speed) and power of your equipment
- feed rate
- use of coolant (type, force, and direction)
- operator experience
- Condition and age of cutting equipment (age will affect the precision, accuracy, and repeatability of cutting).

Surface Finish Quality

The quality of the surface finish is evaluated by the amount of chips generated on the face of the material. A visual inspection is the easiest way of checking surface finish quality. The most common scientific way of measuring surface finish quality is using Ra, or Arithmetic Average Roughness. It basically reflects the average height of component irregularities from a mean line. Ra provides a simple value for basing accept/reject decisions.

Break-in Time

A diamond blade requires time to break in before it can produce relatively chip free performance. The shorter the period of time under which this occurs, the more productive the blade becomes.

Frequency of Dressing

The less your diamond blade needs dressing, the more efficiently you will be cutting.

Diamond blade cost is usually a minor factor in the total cost of the job. Labour and overhead costs are more expensive. Therefore it is important to select a diamond blade that can provide the best performance and productivity, not just the lowest blade cost. The blade should be purchased on the basis of cost per piece cut. United Diamond Tools supply blades that are industry leaders in this area of cutting.

Cutting Wear Plate Materials

If you are having problems cutting wear plate material:

Has the performance reduced, or have you never been able to produce a satisfactory performance? If it has reduced from a previous higher standard, them something has likely changed to cause the drop in performance. It is a process of elimination to locate what has changed and reinstate it. If you have you never been able to produce satisfactory performance, then every factor that contributes to cutting must be examined individually, and modified as such, to find the cutting "recipe" or procedure that achieves the results you need.

**Most importantly of all - Take notes! Note where you are starting from, what you change, and the result it gives. There will be too many details for you to remember all the variations without notes.

Measure What You are Doing

What blade size are you using? What speed is your blade running at? What feed rate do you use? What lubricant do you use? Do you mix it? What pressure is it sprayed at? Do you have several machines - which ones are the problems occurring on? Similarly, are some operators having more success than others. What techniques do they use? How often do you dress the blades?

Check

Check that the job is firmly held down, that lubricant is delivered to the cutting zone, has your tile supplier changed the compound? If you bore out the centre hole, does this cause some dishing in the blade? Is the saw in good condition with a rigid spindle, without loose bearings? Have you changed the machine in anyway?

Trial Alternatives

Can you change the blade speed? Alternatively, change the blade size. Trial thinner blades - United Diamond Tools have new alternatives. Change the feed rate, try a different lubricant or different concentration. Can you try different cutting techniques e.g. step cutting rather than cutting in one pass.

Chapter Three: Troubleshooting

Slow Cutting Rates

- Smeared material on the blade
- Redress blade
- Increase speeds - RPM or feed rate
- Rotate material to minimize cutting area

Chipping

- Use finer grit blade
- Reduce speeds - RPM or feed rate
- Use appropriate coolant for the material
- Material is not securely held in place
- Re dress the blade
- Check saw condition to make sure it is not out of alignment

Slow Cutting Blade

- Redress blade
- Increase speeds - RPM or feed rate

Material Overheating

- Not enough coolant

Blade Not Cutting

- Redress blade
- Increase speeds - RPM or feed rate
- Incorrect blade

Short Blade Life

- Incorrect blade
- Insufficient coolant

Material/Saw Vibration

- Too small flange diameter – needs to be 1/3 blade diameter
- Slow down feed rate
- Material is not securely held in place

Chapter Four: The UDT Alumina Ceramic Range

UDT Rim Cutter Blade

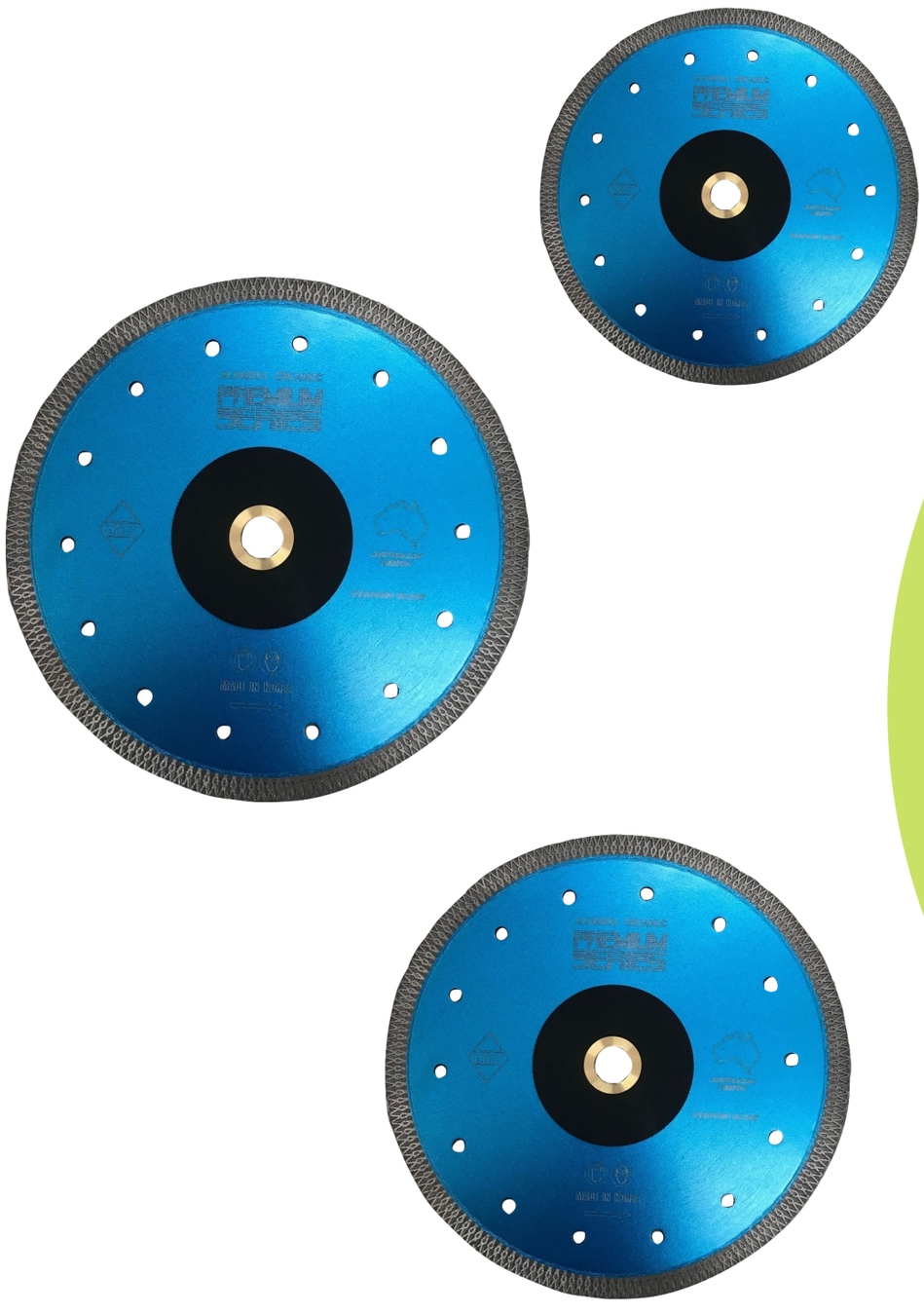
Fast cutting Alumina Ceramic Blade designed to give long life while cutting tile only (not composite tile and rubber).
Excellent performance cutting Alumina Ceramic and with good cutting speed.

7"/175mm
8"/200mm
10"/250mm
12"/300mm
14"/350mm

UDT Super Turbo Blade

Well known, fast cutting blade for alumina ceramic and silicon carbide composite (tile and rubber) or tile alone.
Proven history of excellent performance with a good cutting speed and long life.
Widely accepted through out the industry.

12"/300mm
14"/350mm
16"/400mm
18"/450mm
20"/500mm
24"/600mm



UDT Ultra Thin Turbo Blade

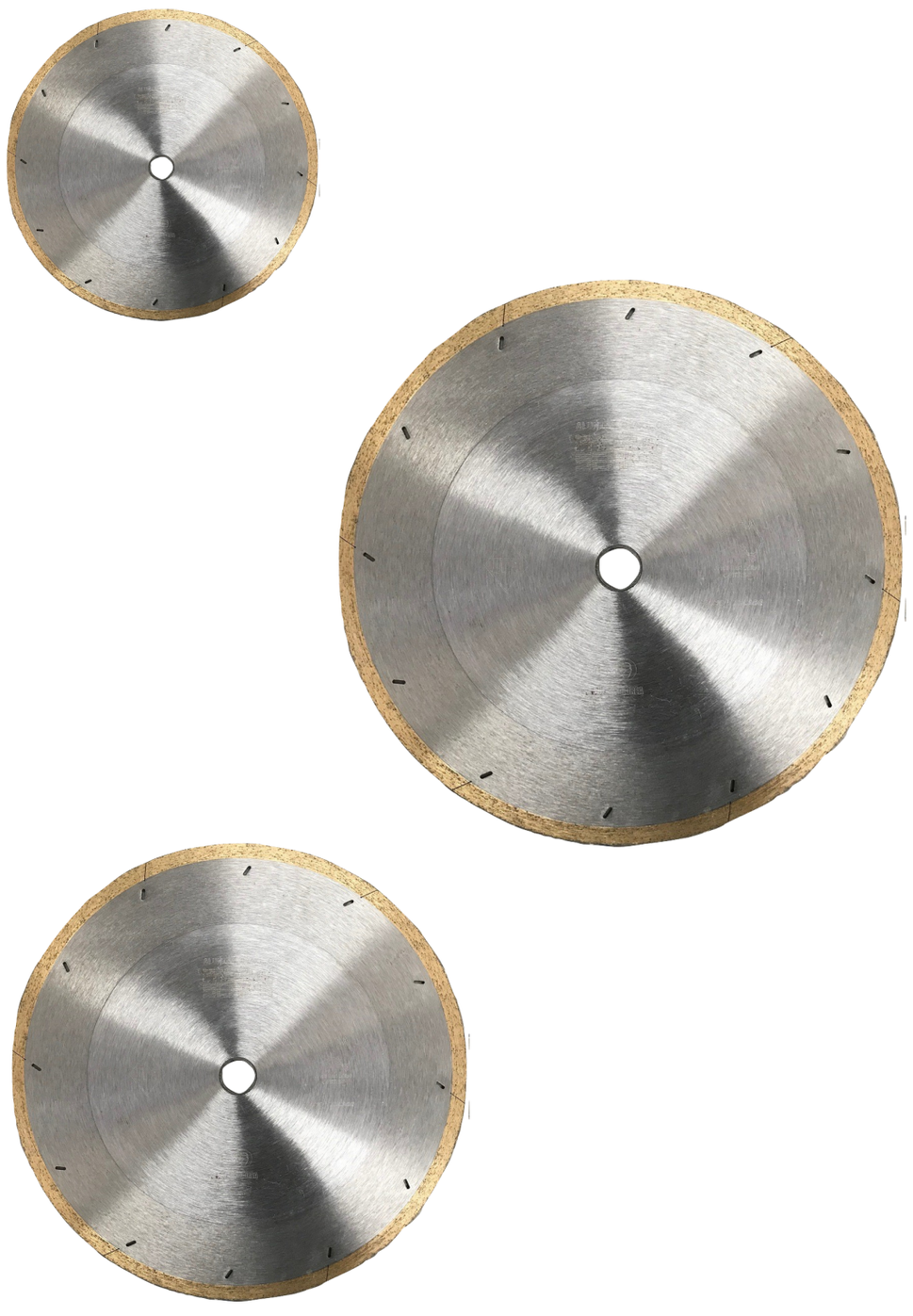
These ultra thin blades have immediately proven themselves with Australia's alumina ceramic cutting industry.They provide the ultimate in clean cuts. With features to stop blade flexing. And they are amazing value as well.

5" - 22.23/16mm centre
8" - 25.4/22.23mm centre
10" - 25.4/16mm centre
12"/300mm (2.2mm thick) blade due Nov 2018

UDT Clean Cut Blade

These blades feature clean cutting and reinforcement in the hub to stop the blade flexing. The soft bond means these blades can cut hard products without chipping.

12"/300mm 50mm cutting depth
14"/350mm 75mm cutting depth
16"/400mm 100mm cutting depth



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UDT Vacuum Cup Wheels

Diamond Cup Wheels suit a wide range of materials from alumina ceramic, steel (including stainless), concrete, stone of many types, and even glass. Vacuum brazed diamond cup wheels are manufactured by welding synthetic diamond particles to the outside edge of the wheel in a vacuum brazing furnace. All of the diamond particles are on the exterior cutting edge of the blade, with no bond/diamond segments like other wheels.
These wheels are recommended for edging and de-burring on any hard materials like Cast Iron, Steel, Concrete, Stone and Alumina Ceramic etc.

UDT Vacuum Cup Wheel - Flat

Vacuum cup wheel - flat
Grits - #35, #50, #80
Suit edging, de-burring and grinding
Rubber backed - reduces noise and damage
22.23mm centre - M14 adaptor available

4"/105mm
4.5"/115mm
5"/125mm

UDT Vacuum Cup Wheel - Round

Vacuum cup wheel - round
Grits - #35, #50, #80
Suit edging, de-burring and grinding
Rubber backed - reduces noise and damage
22.23mm centre - M14 adaptor available

4"/105mm

UDT Diamond Flap Wheels

Diamond Flap Wheels are used for shaping, beveling and grinding edges on natural stone, marble, granite, concrete and terrazzo, alumina ceramic, silicon carbide and engineered stone. They can be used wet or dry, have a fast cutting speed and high stock removal rate. A Flap Disk is easier to use and more forgiving than heavier cup wheels, with much less vibration.
All our flap wheel are made in the EU.

- Gold and Silver lines are available in:
- #60 Grit - Green- For rough grinding and shaping.
- #120 Grit - Black- For semi rough grinding.
- #200 Grit - Red- For smooth grinding.
- #400 Grit - Yellow - For finishing

The KGS **Gold** Line are a Hybrid Flap Disc with extreme grinding and an incredible life time, and very suitable for the straight stone edge. They are made of a plastic body with metal boned diamond flaps. A smooth consistent finish with no chipping is another advantage of these Flap Discs. The Hybrid Flap Discs made from 100% diamond flaps are the value-for-money option compared to cup wheels. The hybrid system uses both flap discs and polishing pads is ideal for aggressive and quick material removal and polishing engineered stone with precise control. The focus is on material removal and deburring and the Hybrid Gold Line is suitable for edge grinding and chamfering as well as surface grinding.

UDT Gold Line Hybrid Flap Wheels

Made from 100% diamond flaps.
Colour coded for easy identification in 60, 120 and 200 grits.
115mm with a centre hole 22.23mm
Optional M14 adaptor (available at extra charge).
10,500RPM maximum
Made in the European Union

The KGS **Silver** Line are a Hybrid T Flap Discs which are economically priced and targeted for use on engineered stone, granite, marble, ceramics and concrete. They can be used wet or dry and are the ideal choice for Concrete Polishers doing edge work. Fast cutting speed, exceptional lifetime, very easy to use, comfortable action with no vibration. A smooth, even finish with no chipping is produced. The Hybrid T grinds softer than the Hybrid.The hybrid system uses both flap discs and polishing pads is ideal for grinding and polishing engineered stone.

UDT Silver Line
Hybrid T Flap Discs

Available 60, 120, 200 and 400 grits.
Color coded for easy identification.
115mm with a 22.2mm centre hole
Optional M14 adaptor (available at extra charge)
10,500RPM maximum
Made in the European Union
4.5"/115mm

The KGS **Shark** Range are economically priced and targeted for use on engineered stone, granite, marble, ceramics and concrete. They are made from a combination of diamond flaps discs and conventional abrasive flaps and comes with a 22.23mm centre hole (adaptor for M14mm fitting available at extra charge). They can be used wet or dry and are the ideal choice for Concrete Polishers doing edge work. Fast cutting speed, exceptional lifetime, very easy to use, and with a comfortable action with no vibration. They give a smooth, even finish with no chipping. The KGS Shark range is an ideal replacement for coarse grinding and shaping using a Cup Wheel.

Coarse Grit (#60) - For rough grinding and shaping.
Medium Grit (#120) - For semi rough grinding.
Fine Grit (#200) - For smooth grinding.

UDT Shark Flap Wheels

115mm in Diameter
Suit most hand held grinders.
Coarse, Medium and Fine
22.23mm hole centre
Shown with optional M14 adaptor (available at extra charge)
10,500RPM maximum
Made in the European Union

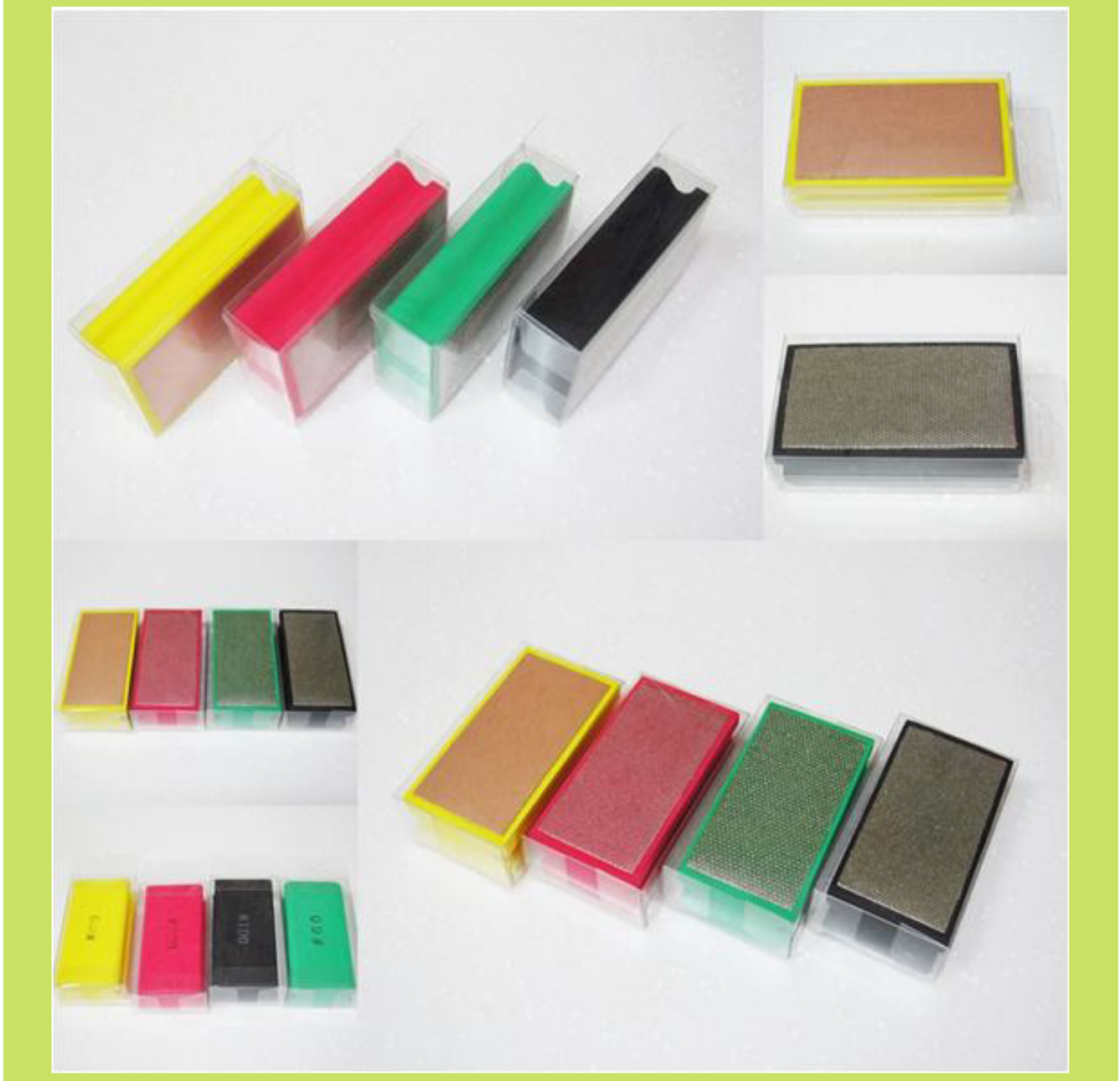
UDT Diamond Hand Polishing Pads

These electroplated diamond hand pads can be used on alumina ceramic, glass, stone, tile, porcelain and concrete and composites.

They measure 100 x 50 x 30mm. Use to remove snags and smooth off edges, roughen or polish glossy ceramic surfaces etc. A large variety of grits is available.

Available In:

- 60 grit very coarse
- 120 grit coarse-medium
- 200 grit medium
- 400 grit medium-fine
- 800 grit fine
- 1500 grit very fine
- 3000 grit ultra fine



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Basic Safety

Here are some basic actions to reduce the risk of any injuries.
Always wear eye and hearing protection!

Careless or improper use of a diamond blade could cause personal injury!

- Do not use any tools if damage is suspected.
- Beware of sun damage to the operator
- Have a fire extinguisher and first aid kit nearby (we sell the Fast Aid kits shown below!)
- Install the blade with the arrow pointing in the rotation direction of the tool.
- Use a blade that is suitable for the machine and the material to be cut
- Check for suitability before cutting dry.
- Check diamond blade for damage before installing.
- Check machine condition before performing any cutting operations.
- Check for a tight fit to the shaft of the machine.
- If using a arbor adaptor, always ensure your blade flanges will clamp the adaptor in place - otherwise the adaptors may come out when used with dished flanges
- Check condition of blade regularly
- Check all electrical cords and plugs (if applicable) and protect them from water.
- Never cut without the safety guards in place.
- Be aware of fume build up even in open buildings
- Do not apply side pressure or use it as a side grinder

FAST AID
First Aid...for life

Find these kits at UDT!

THAT'S IT!

Thank you for reading, we hope you found this guide useful. If you have any more queries feel free to drop in to:

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