



# WATERJET CUTTING BASICS AND **GMA GARNET™** ABRASIVES



# You've made the right choice

Congratulations! For making the right choice in choosing **GMA Garnet™** abrasives for your waterjet machine.

Our high-quality abrasives have been serving the waterjet cutting industries around the world for more than 35 years. And we have continuously offered a consistent product with high purity to ensure maximum productivity and safeguard your machine,

Whether you are a new or an experienced waterjet user in the industry, we hope this guide could provide some knowledge on GMA Garnet™ abrasives, the waterjet machine and how to make the best out of your time and investment to get the return you need.

We are excited to journey with you in exploring the most popular waterjet garnet abrasive in the world!



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# Waterjet Cutting Basics

Abrasive waterjet cutting is a cold cutting (non-thermal) process operated by a waterjet machine. It uses natural garnet abrasives combined with high-pressure water to cut almost any material. This process produces a smooth cutting surface with no slag or heat affected zones.

The amount of pressure used will determine the speed of the water stream. The ultra high pressure pump within the waterjet system can generate between 3800 to 6000 bar (55k to 87k).

The high-pressure water, which is typically generated at 3.8 litres per minute, flows through an orifice with a diameter between 0.10 – 0.33 mm (0.0039 – 0.012 in) into the cutting head, creating a jet stream of up to 1,000 m/s.

At the same time, garnet abrasives are fed into the focusing tube via an abrasive inlet and combined with the high-pressure jet stream. It transforms into a powerful cutting tool that can cut thick metal (up to 30cm or 12 inches) into any shape.

## Why use abrasive waterjet cutting?

In the world of Computer Numerical Control (CNC) manufacturing, computers control machine tools to perform various types of cutting methods. While CNC laser cutting and plasma cutting are quite popular, and offer a faster speed in cutting materials like steel, aluminium and copper, these methods often fall short when extreme precision and flexibility are required.

Waterjet cutting on the other hand, can be used to cut anything from soft rubber and plastics to the hardest metals and ceramics without any heat-affected zones. You can also increase the cutting capacity by mounting two or three cutting heads on the cutting table. These will follow the same contour in parallel, from 2D to advanced five-axis cutting in 3D.

Therefore, waterjet cutting gives you incredible flexibility to adjust to your specific cutting requirement.





Finding an expert in waterjet cutting machines can be an invaluable asset to the success of your jobs.

## Selecting a suitable waterjet system

Selecting a suitable waterjet cutting machine among a list of manufacturers from all over the world is not easy, especially for first-time buyers.

Most satisfied buyers would have performed a lot of preparatory work in researching the pros and cons of their shortlisted machines before placing an order. Waterjet cutting is a process that can be technically challenging. Having a competent and stable partner that can support you is reassuring.

Typically, satisfied customers who have made the right choice will find that their equipment manufacturer provides full support such as high-quality training and good after-sales support of service and parts. Therefore, it is important that you choose an established provider or OEM near you that can deliver these capabilities for many years to come. Trade shows are a good source for researching leading OEMs represented at these events.



## Not all abrasives are equal

Over the last 30 years, waterjet users have experimented with both natural and synthetic abrasives in their cutting projects.

However, Almandine garnet has been identified as the most suitable mineral for waterjet cutting due to its unique characteristics, high performance, and lower operating costs. GMA Garnet™ abrasives consist of hard and tough subangular grains.

Abrasives that are softer than garnet, such as olivine or glass, provide a long mixing tube life but underperform on cutting speed. Abrasives that are harder than garnet, such as Aluminium Oxide or Silicon Carbide, cut faster than garnet but compromise on cutting-edge quality. Moreover, the life span of the mixing tube is also shortened by up to 90% in comparison to garnet.

An additional benefit of using garnet abrasives is the disposal. Garnet is a natural and environmentally friendly product. Used garnet can be repurposed and added to various industrial products such as filler agents in asphalt and concrete products.

### 1 Hardness

GMA Garnet™, which is of Almandine variety, is the hardest form of garnet. It has a higher relative resistance for abrading on the workpiece during the cutting process.



### 2 Toughness

It is also one of the toughest garnet varieties. Therefore, it won't break down easily (less friable) while combining with the high pressure jet stream or cutting through material.

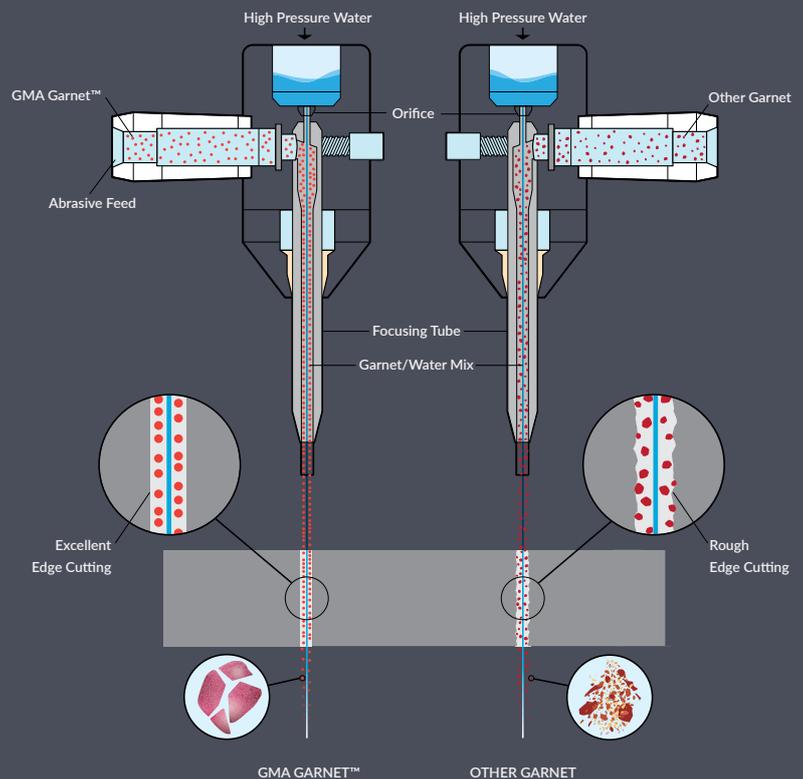
### 3 Density

High density and even particle size garnet grains create the ideal kinetic energy for achieving a consistent flow at every stage of the process.

# Not all garnets are equal

There are several garnet products available in the market, but not all garnets are equal. Using a high-quality product maximises your production and safeguards your equipment.

Premium quality abrasives like GMA Garnet™ deliver consistent cutting performance. Its heavy garnet particles combined with the high-pressure water stream accelerate to maximum velocity to generate the maximum cutting force.



## Here are some key considerations you should look for in choosing your abrasive:

### Excellent cutting performance, lowest abrasive consumption

When you measure the long-term profitability of a waterjet cutting operation, it is important to focus on the cutting speed and abrasive consumption per minute. GMA Garnet™ delivers the perfect balance between cutting speed and quality. Compared to other abrasive substitutes in the market, GMA Garnet™ cuts quicker at a lower abrasive feed rate to achieve optimum performance, accuracy with the best possible cutting edge quality.

### High purity, consistent garnet sizing

Frequent focusing tube blockages are caused by dust and oversized abrasives. The use of high purity and consistent particle sized garnet enables garnet free flow and protects your machine and parts from damage and accelerated wear and tear.

GMA's advanced garnet processing technology ensures that every batch of GMA Garnet™ – which was laboratory tested twice – contains highly accurate sized grains of the purest almandine garnet.

Using GMA Garnet™ creates less wear and tear on your cutting equipment and increases the longevity of your feeding tubes, thus reducing the overall equipment maintenance costs.



### **Reliable Supply**

GMA has full control of our supply chain from our mines to your door. It gives us the capability to maintain a stable supply of garnet for your business and especially for customers in the essential industries.

Our established global distribution network enables our logistics teams to schedule the quickest and most affordable delivery options for local and international orders.

### **Abrasive cost vs operational cost**

It's a fact that high-quality products come with a higher price. On the surface, you may seem to be spending more if you base the cost on abrasive alone.

However, if you were to factor in the high productivity, fewer parts replacements and uninterrupted production, the overall operational cost will work out to be significantly lower. Moreover, the quality work you produce will keep your customers coming back for more!

# Calibrate your machine to run at optimal performance

Experienced waterjet cutting operators will conduct calibration checks whenever they upgrade their machine or use a different type of garnet abrasive. The reason being, the flow and garnet consumption levels may no longer be the same.

It is also important to take note of the machine's specifications provided by the manufacturer. It describes the type of orifice, focusing tube and garnet abrasive that can be used for the new machine.

By doing so, you will achieve the desired garnet consumption rates and reduce wear and tear on your waterjet parts.

## Run a cutting test

When you introduce a new type of garnet to your waterjet machine, it is recommended that you conduct calibration and cutting tests.

As discussed earlier, not all garnets are equal. Different types of garnet abrasives and mesh sizes may significantly affect the cutting quality and consumption rate. Therefore, you need to adjust the machine's setting to achieve the optimal balance between performance and consumption.

During a cutting test, do take note of the following parameters:

- Cutting speed
- Cutting edge quality
- Consumption level (grams/minute).

*Note: The cutting speed should only be affected by the thickness and type of cutting application.*



# Abrasive Consumption: 'More is not always better'

When it comes to the amount of garnet abrasives used in your waterjet cutting operations, more is not always better as it can cause an opposite effect.

Overfeeding your machine may compromise cut quality and reduce cutting speed and overall efficiency. When you feed your machine with an excessive amount of garnet, the abrasive can tend to chug or come out sporadically or intermittently.

In this case some operators think it may be starving the machine, and they need to increase the amount of garnet coming from the Abrasive Regulator (AR, more on that later). In fact that is overcompensating and have the opposite effect and will continue to run inefficiently.

Therefore, you need to set the right amount of garnet for mixing with the high-pressure water, and the result is they both flow perfectly through the mixing tube onto the material that it is cutting for optimal performance.

## Getting the feed amount right

The way to measure the amount of garnet to be fed to the cutting head is through the mini hopper, also referred to as an Abrasive Regulator (AR). The unit is typically mounted on the rail of the waterjet machine, above the cutting head.

The AR feeds garnet to the cutting head typically by gravity. It will usually have several settings that determine at what rate, or how much garnet goes to the cutting head.

Most waterjet OEMs will have a guide for standard abrasive feed amounts. While these are suggested starting points, they are not necessarily the best or most efficient. For example, for a particular setup, it might suggest a setting of 0.54kg (1.2 lbs.) of garnet per minute.

A simple test to see if that is the best setting; try reducing the amount of garnet fed via the AR. Go down to 0.49 kg (1.1 lbs.) per minute, and if you are still achieving the same cut finish and edge quality, then drop down to 0.45kg (1 lb.) per minute. Continue to adjust the settings until you see a noticeable or



unacceptable difference in the cut quality that you are trying to achieve.

In many cases, you can reduce the amount of garnet abrasive used for your waterjet cutting operations and still achieve a similar or many times, a better cut. When you cut faster and use less garnet, you are reducing your overall costs and becoming more productive at the same time. Which in this case, 'more is certainly better'!

# Find the perfect fit: Selecting the right Nozzle and Orifice

Selecting the right combination of nozzle and orifice plays a vital role in achieving the best cut quality with minimum Kerf and minimising nozzle wear which adds to your project's profit margin.

The orifice is a metal disc that contains an industrial gem mainly from rubies, sapphires, diamonds and tetraCore™. It focusses the waterjet stream and enables it to reach the immense velocities required for any cutting applications. The high-pressure water is then combined with abrasive and channelled through the nozzle to perform the cutting.

Waterjet manufacturers around the world have conducted extensive testing with various orifice and nozzle combinations and the right amount of abrasive with consideration to cost and cutting speed.

The chart provides a guide for selecting the right orifice size(s) according to the pump size. For example, the 0.018" orifice or two 0.012" orifice is suitable for a 75 HP pump.

Max # Orifices	30 HP	50HP	75HP	100HP	150HP
1	0.011"	0.014"	0.018"	0.021"	0.025"
2	0.007"	0.010"	0.012"	0.014"	0.018"
3	0.006"	0.008"	0.010"	0.012"	0.014"
4	0.005"	0.007"	0.009"	0.010"	0.012"
5	0.004"	0.006"	0.008"	0.009"	0.011"
6	0.004"	0.005"	0.007"	0.008"	0.010"

As for selecting the correct nozzle size, the general rule practiced in the industry is the nozzle bore should be 3 times the orifice size.

Here are the possible combinations:

Nozzle Bore Diameter	Orifice Size
0.030"(0.76mm)	0.010"(0.25mm)
0.036"(0.91mm)	0.012"(0.30mm)
0.040"(1.02mm)	0.013"(0.33mm)
0.040"(1.02mm)	0.014"(0.35mm)
0.043"(1.09mm)	0.016"(0.40mm)



# Keep your garnet safe and dry

Managing your abrasives well not only maximises your resources but also ensures a trouble-free and uninterrupted cutting operation.

Before we talk about the proper handling and storage of your garnet abrasive, it is important that you prevent your garnet from any moisture exposure.

Wet abrasives can get compacted and harden in the hopper. If you then feed it to the cutting head, it may stick to the feed hoses or comes out in lumps – you risk clogging the feed regulator. That's why GMA Garnet™ product packaging is designed with plastic inner liners.

## Useful tips on garnet storage



First and foremost, train your employees on the proper handling of garnet abrasives, including best work practices.



Store your garnet abrasives indoors and in a dry place. Garnet stored in polypropylene bags must be kept out of direct sunlight to avoid UV degradation.



Keep the packaging tightly closed and in a well ventilated place without large temperature swings to prevent condensation.



Place paper and bulk bags on pallets and not directly on the floor. Be aware of opened bags near the waterjet cutting machine as it can be exposed to water splashes from the machine.



Identify a safe and low-traffic storage location in your warehouse to avoid potential damages to the bags.



*Another point to note: We recommend that you check the goods received for any damages on the packaging that may have occurred during the delivery.*

# About GMA

GMA Garnet Group (GMA) is the trusted global leader in industrial garnet and has been providing the highest quality garnet abrasive to the waterjet cutting and protective coating industries for over 35 years.

GMA is the only global garnet supplier with full control of the supply chain from source and processing to international distribution. We own our mines and processing plants in Australia, the USA and the Middle East. Over the years, we have invested significantly to expand our sources of supply and production capacity to incorporate alluvial, crushed and recycled garnet.

## Quality Assured

GMA takes pride in the fact that our product is undisputedly the highest quality natural abrasive and cutting medium available in the world today. The entire production process, from mining and processing to administration, is certified under various international quality standards, including:

- **ISO 9001:2015** (Quality Management Systems)
- **ISO 14001:2015** (Environmental Management Systems)
- **ISO 45001:2018** (Occupational Health & Safety Management Systems)
- In compliance with **ISO 11126-10:2017** for free silica content.

## Industry Applications

METAL FABRICATION



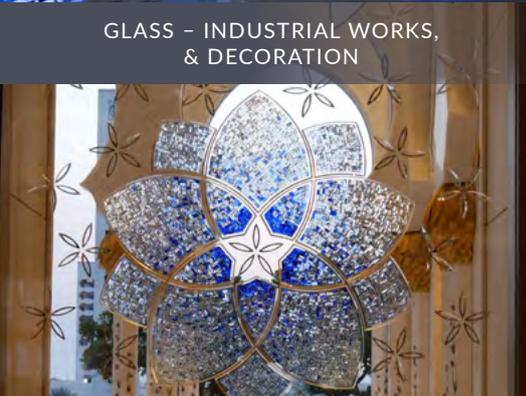
AVIATION



STONE – MARBLE, GRANITE,  
CERAMICS & TILES



GLASS – INDUSTRIAL WORKS,  
& DECORATION



AUTOMOTIVE



MICROCUTTING



# Global Distribution Network



GMA Global Offices Asia Pacific: Perth | Americas: Houston | Europe: Hamburg | Middle East: Dubai, Jubail

## Delivering beyond abrasives

GMA draws from our heritage, our innovative spirit, and our commitment to our people. Our customers trust us for our consistent quality and secure supply and we strive to provide deep expert advice that solves customer problems and enables them to do their jobs well. We understand our customers and develop our products to best meet their needs.



Secure Supply



Consistent Quality



Customer Focus



Technical Expertise



Recycling



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ASIA PACIFIC | AMERICAS | EUROPE | MIDDLE EAST