

Engineering Your  
Competitive Edge



# ROCTEC® Composite Carbide

*ABRASIVE WATERJET NOZZLES*



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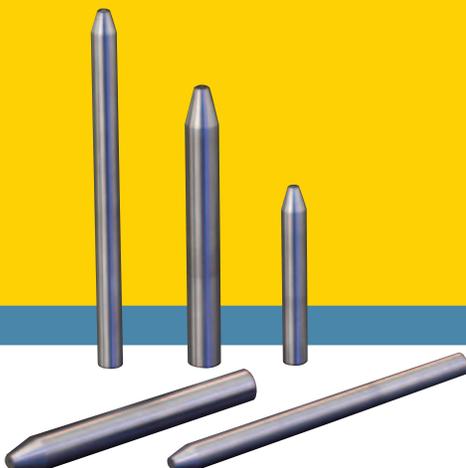
*Our exclusive ROCTEC® line of abrasive waterjet nozzles is made from a patented carbide material and proprietary manufacturing process.*



## ROCTEC® Composite Carbide: The Ultimate Wear Material

ROCTEC® AWJ nozzles are made from unique, patented materials that are literally changing the definition of wear resistance. ROCTEC® composite carbide is a tungsten carbide based material made using the patented Rapid Omni directional Compaction (ROC) process only Kennametal is licensed to use for these products.

The ROCTEC® process enables the combination of these advanced ceramic materials without the need for a soft metal binder, as is the case with tungsten carbide/cobalt using traditional sintering technology. The ROC process enables nozzles to be formed using very short consolidation cycles to minimize the natural tendency of ceramic particles to grow in size when exposed to high heat for long periods. Eliminating a metallic binder and maintaining extra-fine grain size both contribute to optimum nozzle performance. The result is an extremely durable material that fiercely resists abrasive and erosive wear.



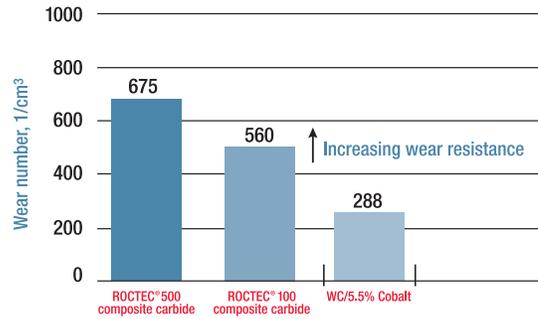
## Superior performance by every measure

Superior wear resistance means a reduction in the number of nozzles purchased over time. Longer life also results in an optimum jet pattern and increased velocity. This allows faster average cutting speeds and significantly reduced system downtime for nozzle replacement and system calibration. It also means greater dimensional accuracy and the ability to perform longer, uninterrupted cuts. These performance enhancements combine to make the entire cutting process more cost-effective.

Without an efficient nozzle (focusing tube, mixing tube) all the advantages of abrasive water jet (AWJ) cutting technology are severely restricted. Cutting speed is reduced. Usage of water and abrasives escalates. Cutting precision is diminished as the original optimum jet pattern and abrasive velocity are lost. Reject rates increase. System downtime increases as time must be spent to check and change nozzles and monitor their performance before getting the system back up to full production.

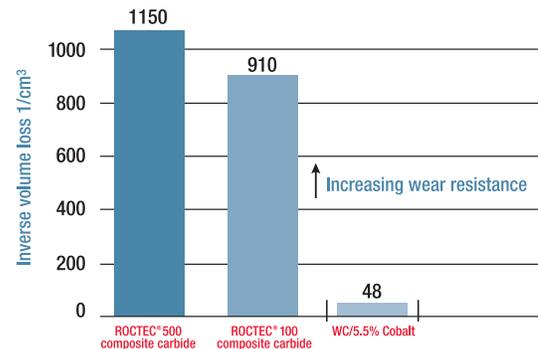
The biggest factor in nozzle efficiency is wear resistance. If you can maintain optimum jet patterns and abrasive velocities longer, all productivity and quality measures increase. The return on the large investment in your AWJ cutting system multiplies. The biggest factor in nozzle wear resistance is the material from which they are made. ROCTEC® nozzles are made from a unique material system made possible by a unique processing technique.

ASTM G-65 Dry Wheel Abrasion



ROCTEC® 100 composite carbide demonstrates wear resistance at 2.5 times greater than tungsten carbide/cobalt in this test.

ASTM B-611 Abrasion Slurry



Wear resistance of ROCTEC® 100 composite carbide has been measured at 19 times greater than tungsten carbide/cobalt in this test.

*Comparative test results vs. tungsten carbide/cobalt using the most relevant ASTM testing methods.*

“ I consider Kennametal's **ROCTEC®** Composite Carbide material to be one of the enabling technologies for modern abrasive jet machining. Prior to its introduction, mixing tube life was of the order of 1 to 2 hours and the jet could change its characteristics during the cutting of a single part. The factor of 40 drop in wear rate afforded by the **ROCTEC®** material enabled the formation of the stable abrasive jet needed for precision machining. ”

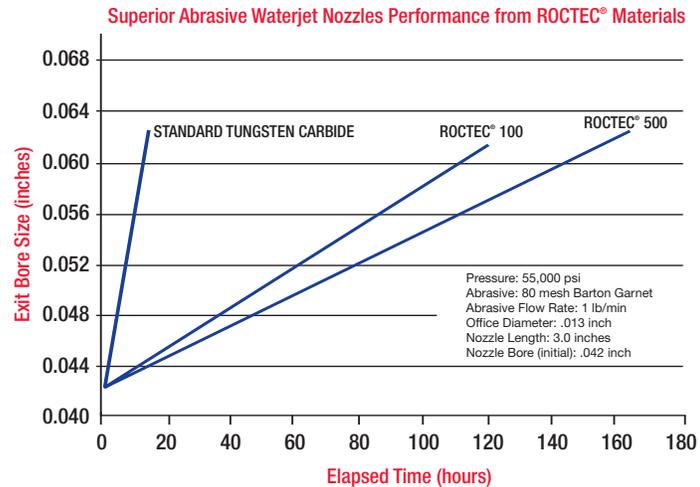
Dr. John H. Olsen, VP Operations, OMAX Corporation

## IN ABRASIVE FLOW PRODUCTS

All leading abrasive water jet system manufacturers design their systems with ROCTEC® AWJ nozzles!  
It's easy to see why...

### Main Characteristics

- Consistent and Long Service Life
- Wear Resistant
- High Hardness Vickers 25.5-27.7 kg/mm<sup>2</sup>
- Long Service Life vs. Tungsten Carbide



As shown, comparative testing documents the extended service life provided by both ROCTEC® 100 and ROCTEC® 500 nozzles versus products made from tungsten carbide/cobalt.

### Other AWJ system parts available in ROCTEC® composite carbide

Any part of your AWJ cutting system subject to erosion by abrasion can affect your system's productivity and is a prime candidate for replacement with a part made from ROCTEC® composite carbide. Today, many equipment manufacturers are also using ROCTEC® materials for ricochet plates to protect other high-cost tooling components. Many catcher plates are also being made from longer-wearing ROCTEC® material. It pays to ask your equipment provider if ROCTEC® parts are available. If not, contact us directly for help.

### Applications

- Waterjet Nozzles
- Slurry Nozzles
- Mixing Chambers
- Centrifuge Nozzles
- Sandblast Nozzles
- Separation Cups for Fluids and Solids
- Descaling Nozzles

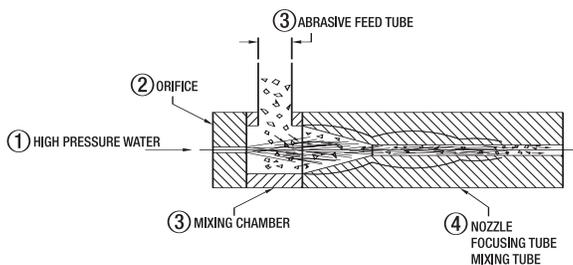


## Abrasive Waterjet Nozzles: The Mechanics

In Abrasive Waterjet (AWJ) terms, the term nozzle generally references the complete cutting head system as depicted. The cutting head includes several components:

1. The high-pressure water delivery component
2. The water orifice or jewel, (generally 1/3 the size of the focusing tube, mixing tube)
3. The abrasive feed inlet and nozzle mixing chamber
4. The focusing tube, also referenced as mixing tube and nozzle

### AWJ Mixing Tube Wear Patterns



Orifice materials are usually sapphire, ruby, or diamond with sapphire being the most common. Diamond is currently gaining in popularity due to its reliability, extended life, and lower operating cost per hour of usage. Sapphire orifices are prone to chipping and a chipped orifice will also lead to diminished cut quality and shorten the focusing tube life. Sapphires need to be inspected frequently and changed to prevent premature focus tube wear.

Water quality also plays an important role as minerals can build up on the orifice. Dirt or abrasive particles can sometimes work their way above the orifice and can lead to problems. Periodically the orifice may need to be cleaned to ensure cutting quality.

The mixing chamber is another area that can potentially affect focusing tube wear. Many of today's cutting heads include mixing chamber components made of steel. These components can wear down and change the cutting stream quality and lead to diminished cut quality and shorted focusing tube life. Kennametal manufactures many mixing chambers from ROCTEC® composite carbide and special tungsten carbide grades thereby minimizing wear to the mixing chamber area and ensuring longer cutting precision and quality.

Three areas of concern:

1. Misalignment between the orifice and the focus tube
2. Chipped orifices
3. Mixing chamber wear



*If the jet is misaligned and allows the stream to hit the tube wall, the cut quality will diminish and the tube life will be shortened dramatically.*



*Good tube wear will be concentric and consistent from entry to exit showing a wave like wear pattern.*

*Water orifice misalignment causes premature wear on the focusing tube. To achieve longer life focusing tubes, make certain that orifice alignment is centered with water only prior to abrasive selection. Turning the focusing tube 120° also increases concentric wear.*

The term nozzle can sometimes be confusing because it can reference the orifice, mixing tube or the complete cutting head system. Within the system, it is very important that the orifice and focusing tube be precisely aligned to ensure a quality, coherent cutting stream by focusing the jet directly down the center of the tube. If the jet is misaligned and allows the stream to hit the tube wall, the cut quality will diminish and the tube life will be shortened dramatically. Misalignment causes deep pockets to be worn into the focusing tube and a "tear drop" shape when viewed from the exit end.

Today's alignment requires precisely machined components and clean assembly to provide error free alignment every time. Kennametal nozzles are machined to provide ID to OD concentricity over the entire tube length to provide a straight tube for precise alignment. Good tube wear will be concentric and consistent from entry to exit showing a wave like wear pattern. Focusing tubes with precise alignment will allow the longest life and highest cut quality. Remember, the longer the mixing tube length the more difficult the alignment will be, especially for smaller inner diameters like .030" and below.

### Why more leading equipment manufacturers design their systems around ROCTEC® Nozzles

- Lowest total cost per hour used
- Up to 80 hours of precision cutting
- Up to 140 hours of rough cutting
- Faster cutting speeds
- Greater dimensional accuracy
- Longer uninterrupted cuts
- Greater performance and service life
- Predictability-nozzles perform the same every time

### Conclusion:

Seek out and stay with the global leader. Nothing comes close to ROCTEC® composite carbide nozzles in wear resistance and quality performance. Since the nozzle is the most critical component of every AWJ cutting system, it pays to make sure they are always installed on your system. Chances are your equipment provider designed its system around a ROCTEC® nozzle and will automatically provide replacement ROCTEC® nozzles. But to make certain, contact your equipment provider. If they are unable to deliver authentic, patented ROCTEC® AWJ nozzles, contact Kennametal Boride Abrasive Flow Products.

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Boride Abrasive Flow Products

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