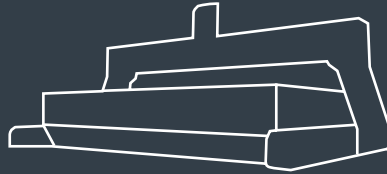


A close-up photograph of a waterjet cutting machine. The machine's nozzle, which is yellow and black, is positioned above a metal workpiece. The workpiece has a circular hole that has been cut. The background is slightly blurred, showing the industrial setting of the machine.

14

# Reasons You Need A Waterjet



Making a capital equipment purchase involves a complex process of needs assessment and product evaluation. Whether the goal is to expand into new markets, improve productivity, or reduce costs, investing in new equipment can be a stressful experience.

In your machine shop or fabrication shop you may find yourself in this position as you look to survive in a highly competitive market.

To take advantage of advancing technology, many shops are looking to incorporate additional cutting equipment into their CapEx budgets. As they evaluate options, they need to decide which equipment is best suited for their businesses.

One clear option should be waterjet cutting. Recognized as one of the most versatile and fastest growing cutting processes used in manufacturing around world, waterjet continues to augment and replace other cutting technologies.

This eBook will outline  
14 reasons you should  
consider a waterjet cutting  
system as part of your  
equipment acquisition plan.



## Waterjets Are Highly Productive

1. Versatility to expand your business
2. Efficiency improvements through pressure
3. Productivity improvements through reduced labor
4. Fast turnaround
5. Complements existing technology
6. Precision to take on profitable work

# #1

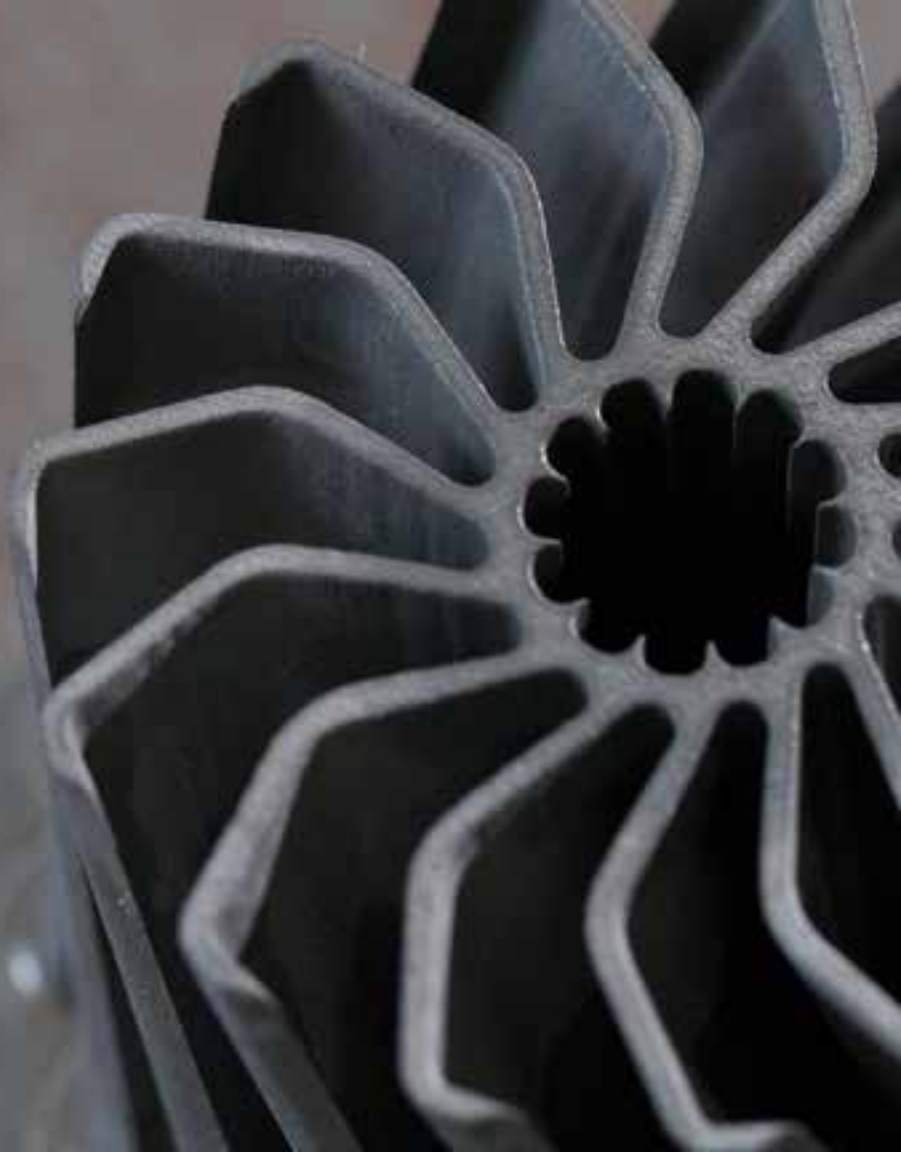
Versatility to expand your business

# Waterjet has proven to be able to do things other cutting technologies simply can't.

With a waterjet system, you can handle any project that comes into your shop including cutting whisper thin details in stone, glass, and metals, rapid hole drilling and cutting of thick titanium, and cutting foam.

Not only can a waterjet handle your basic materials, it is ideal for hard to cut materials including nickel alloys, copper, carbon fiber composite, G-10 or FR4 composite, fiberglass, tile, industrial ceramics, as well as soft materials like gasket, foam, and plastic. Waterjet can cut titanium faster than steel, nickel alloys at the same speed as steel, and always produce the best edge – satin smooth with no heat affected zone or mechanical stress.

When dealing with particularly brittle materials such as stone, glass, composites, and ceramic, waterjet is able to pierce its own start hole with an accessory like Flow's UltraPierce™ and then cut any shape you can draw. Waterjet also gives you the capability to cut extremely intricate detail (0.015 – 0.025" [0.381 – 0.635 mm] inside radius for abrasive waterjet, and 0.002" [0.05 mm] for pure waterjet).



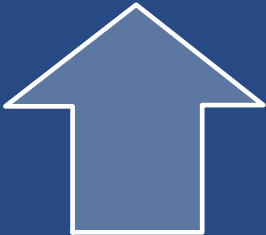
# #2

Efficiency improvements  
through pressure

There are virtually no limits to what waterjets can cut – the driving force behind its rapid adoption by companies of all sizes. But the move to waterjet would have slowed considerably if it wasn't for constant improvements in process efficiency.

The biggest efficiency gain in waterjet cutting involves the reduced use of abrasive – a key factor since abrasive makes up over half the machine operating cost. In recent years Flow has raised the waterjet pressure from the standard ultrahigh-pressure levels of 50,000 to 60,000 psi (3,800 to 4,150 bar) to HyperPressure™ pump ratings of

94,000 psi (6,500 bar). As pressure increases, the stream diameter shrinks, the stream velocity increases, and less abrasive is used. Pressure equals productivity in waterjet so this dramatic jump to HyperPressure™ reduces the abrasive consumption by 1/3 or more, making the waterjet machine much more efficient.



Pressure



Stream Diameter



Stream Velocity



Abrasive Use



# #3

Productivity improvements  
through reduced labor

## Labor is the key driver when it comes to a shop's productivity.

Businesses optimize their labor use by maximizing the number of machines one operator can run, reducing first article part errors caused by programmers or operators, and minimizing programming time for each part. To meet these demands, today's waterjet systems are equipped with intelligent CAD/CAM/Control software, sensors and diagnostics, and warning/shut down sensors. This technology helps shop owners achieve significantly higher productivity levels than were possible in the past.

Advanced waterjet technology makes it safe and easy for one operator to run multiple systems. Machine warnings and shutdowns are built in throughout the mechanical, electrical, and ultrahigh-pressure system and indicators for all alerts appear on the operator screen. Additionally, specific warning details are shown on a diagnostic screen. If an operator fails to acknowledge the alert, the system will automatically shut down. Only manufacturers that build fully integrated systems – like Flow – can provide this type of functionality.

The benefit of this technology is reduced labor costs amortized over more machines, more uptime thanks to sensor alerts, and lower required labor resources due to the ability to have machines running semi-attended.

# #4

Fast turnaround

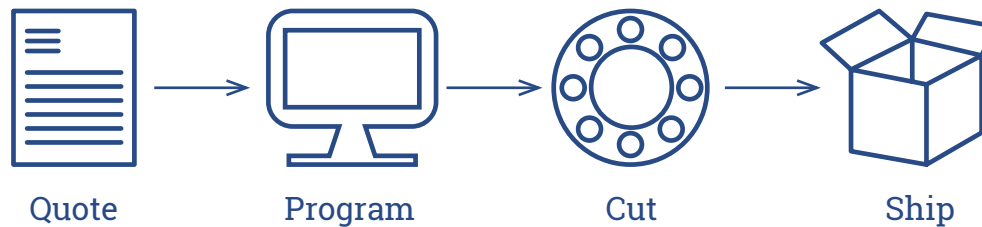
Waterjets typically vary only cut speed going from one material to the next and cutting forces are very low, resulting in very short art-to-part. This attribute is very unusual in manufacturing. The equipment is extremely quick to setup without the need to change cutting parameters such as water pressure, abrasive type, abrasive flow rate, and orifice size when going from one material to the next.

With some advanced controls, like the FlowMaster® intelligent control system from Flow, you enter the material type, the thickness, the quality required, and the system does the rest. There is no need for the programmer or operator to go to a look up table to approximate or interpolate a speed, or to make a series of test cuts or cut scrap parts. The intelligent control system knows how to cut the part and controls the stream on arcs and corners to produce the right part the first time.



Programming is very fast when it comes to creating the program path, whether in 2D (FlowMaster) or solid model 3D (FlowXpert®). These intelligent programming packages are the result of 40 years of Flow waterjet experience. They automatically create the cut path of the drawing you import or create, placing the jet start stop at the right points, setting the proper cutter compensation, and highlighting or solving pattern errors before the operator begins the cut.

Quoting projects is also faster today. Once you program the part, the system delivers the machine operating cost and the cycle time to produce it. You can then apply machine set up, part packaging and shipping, labor, and overhead as separate items. Accurate quoting is not only needed for a job shop, it is also a common requirement for in-house manufacturing.



# #5

Complements existing technology

Waterjet can certainly replace plasma, laser, milling, routers, and EDM for many applications, but more importantly, most shops find that waterjet complements these other technology investments thus improving overall shop efficiency.

A plasma system may be faster and less expensive than waterjet if you are rough cutting mild steel between 1/8 and 3/4" (3.175 and 19.05 mm) thick. But if you need to grind the edge to remove heat affected zones (HAZ) or need a precise part, then waterjet is a more cost-effective alternative for the overall project. As a cold cutting process, no HAZ or mechanical stresses are left on a waterjet cut surface saving process steps, time, and potential errors. Also, plasma only cuts electrically conductive material where waterjet can cut just about anything. Finally, a waterjet equipped with Dynamic Waterjet® technology can easily produce a finished part to two or three thousandths of an inch (0.0508 to 0.0762 mm) with inside radius detail of twenty thousandths of an inch (0.508 mm) – far tighter than today's most advanced plasma systems.



Laser systems cut with heat, and so will only cut materials with the right thermal properties. For important aerospace parts, heat cut surfaces are not allowed so waterjet is ideal for many aerospace applications. Laser cuts fast and accurately for thin sheet metal, especially mild steel, but waterjet can become productive for thin sheet metal when the material is stacked to about 0.6" (15.24 mm) thick. Waterjet can also cut materials other than mild steel at nearly the same speed, or faster, than laser – especially when the materials are highly reflective (Aluminum and copper, for example) – which are difficult for a CO2 Laser to handle.

A high powered laser is most effective cutting from very thin sheet metal to approximately 3/8 of an inch (9.525 mm) and maxes out at approximately 1 inch (25.4 mm). A basic waterjet can cut any material to any thickness, even those over one foot thick, although high precision cutting with waterjet is limited to material thickness of approximately three inches. Waterjet's satin smooth edge and lack of any heat or stress is simply far better than anything cut via a heat process.

In general, each technology has its own specific sweet spot, but waterjet provides huge flexibility because it overlaps with other cutting methods and can do things that others cannot.





# #6

Precision to take on profitable work

## Waterjet systems like the ones from Flow are available with different levels of precision capability.

A machine tool equipped with a basic waterjet cutting head, sometimes called a conventional waterjet head, can cut a +/- 0.010" to 0.015" (0.254 to 0.381 mm) accurate part out of any material up to approximately 3" (76.2 mm) thick. Beyond that the finished part is less precise. It is possible to cut a part to tighter tolerances with a conventional waterjet, but to cut to +/- 0.005" (0.127 mm) tolerance the machine cut speed must be reduced to approximately 10 to 15% of maximum cut speed. This slow speed is needed to minimize corner washout caused by stream lag, and part taper caused by the V-shaped kerf created by the jet at high speed. Slower cutting reduces these errors, but takes longer so is more expensive.

However with Dynamic Waterjet®, the head can be tilted while cutting, thus compensating for the V-shaped taper and the stream lag corner washout. This enables cutting at a much higher speed while also increasing the accuracy of the parts from 0.010" (0.254 mm) accuracy to 0.002" (0.0508 mm). The positional accuracy and dynamic motion characteristics of a machine have an impact on part accuracy and precision. Waterjet machines from Flow are built to minimize the effect this motion has on precision via closed loop (velocity and position) digital drives and motors, precision motion technology, and extremely rigid machine tool design.





## Waterjets Are Cost Effective

- 7. Reduced material waste
- 8. Reduced capital cost
- 9. Less maintenance

#7

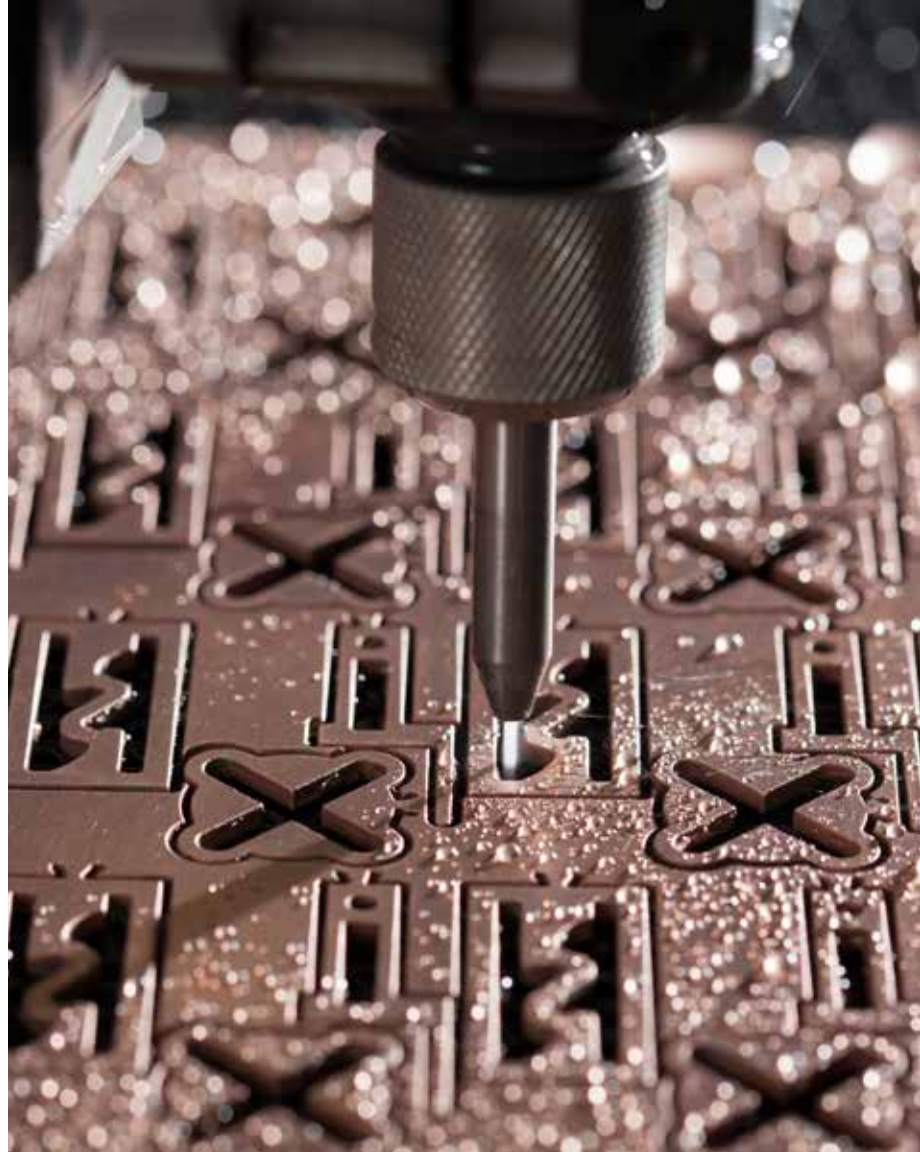
Reduced material waste


Improving material utilization adds cash directly to the bottom line. Fabrication shops usually cut from large plates and machine shops normally cut from bar stock or smaller work pieces.

## Each looks at saving material in different ways.

Machine shops that mill parts find that the size of the cutting tool affects material utilization. Removal of a large amount of material from a stainless steel part, for example, might require a larger diameter end mill and cause material waste. Since the waterjet cutting stream is 0.030" to 0.040" (0.762 mm 1.016 mm) in diameter very little material is wasted. This might mean that more parts can be created from the raw stock.

Advanced machines incorporating Dynamic Waterjet® technology can produce parts up to three inches thick to a few thousandths of an inch accuracy much faster than taking multiple passes with a milling machine. Solid scrap is worth 2x to 10x more than metal scrap in chip form.





Abrasive waterjets typically produce edge finish of 125 Ra – a satin smooth edge that appears to have been finished by a fine-grit sand blaster. There are projects where the surface finish needs to be better than 125 Ra, where required finished part tolerance tighter than two thousandths of an inch is required, or when pocket milling, threading, or other interior work is needed. In those cases, many machine shops find that using the waterjet to rough the part out at high speed and then finish it off on the mill saves considerable time and material. For example, a shop can save significant time by taking a piece of titanium and having a waterjet cut it to +/- 0.005 inch (0.127 mm) accuracy at high speed, and then get it down to 0.001 (0.0254 mm) in a mirrored surface finish with a mill. Titanium and other exotic alloys are often very difficult to machine with a mill. The final milling process can be fast and efficient, because roughing with the waterjet leaves behind a virgin surface free of any mechanical stresses or heat hardened areas.

For Fabrication shops, the waterjet provides a number of material utilization advantages. Because waterjet is a cold cutting process, adjacent parts can easily be cut without issue. On a plasma or oxy acetylene cutting system, you have to leave a 1/4 to 3/4" (6.35 to 19.05 mm) gap between parts so the heat of the second cut doesn't ruin the previous cut edge.

The thin kerf and cold cutting nature of the waterjet frees the programmer to optimize the nest as tightly as possible. Most waterjet nesting software includes the capability to set common line cutting, where one pass is used as the cut edge of two adjacent parts. The remnant left over after cutting a nest can be used later since the waterjet did not harm, heat, stress, or warp the material in any way.

# #8

Reduced capital cost

## Capital investment for a waterjet system is very reasonable by machine tool standards.

Machine Type	Approx. Purchase Price <i>(for 4 x 2m)</i>
EDM	\$125K
Plasma	\$140K
Waterjet	\$160K
Fiber Laser	\$250K
CO2 Laser	\$500K

The cost for a CO2 laser, for example, will be anywhere from \$300K to \$1.2M. Some fiber lasers today can be somewhat less expensive than the CO2 since they require less elaborate mechanical structure due to the lack of precision optics. A waterjet will fall in the \$80K- \$350K range with an average price of about \$160K. This is closer to the cost of plasma or router cutting systems, but you get the precision and added capability of waterjet.

There are also upgrade possibilities with a waterjet system investment. For example with Flow equipment, you can start with a less expensive basic system and as workload and your financial situation allows, upgrade from a lower pressure pump to a HyperPressure™ pump, add Dynamic Waterjet®, then add other enhancements as you grow. In addition, the Flow Mach Series provides you with the option of starting at a variety of price/capability points. You can begin with a more affordable Mach 2 or jump right to the more advanced Mach 4, selecting the performance, features, and price that best fits your operational needs and budget.



# #9

Less maintenance

Maintenance time, operating cost, and uptime can be optimized with a waterjet system. If you have a service contract with an OEM partner like Flow, then the basic maintenance of the high-pressure system are all taken care of by highly skilled local service engineers. All you have to do is replace consumables, such as adding garnet abrasive and changing the orifice and mixing tube. Waterjet is inherently simple to understand, so any unexpected service issues are quickly identified and rectified. This is not the case with other systems like laser where the technology is not readily understood without advanced degrees in physics.

The latest HyPlex® direct drive and HyperJet® intensifiers technology from Flow come with a preventative maintenance program that improves uptime. Maintenance is scheduled when it's convenient to your operation after a milestone of run hours is met. The service, often performed by Flow under service contracts, is performed quickly to minimize production interruptions. During these maintenance cycles, the Flow technician on site can help with programming questions, difficult project applications, and other issues you need to discuss.





## Waterjets Are Revenue Generators

- 10. New word of mouth business opportunities
- 11. Competitive advantage

# #10

New word of mouth  
business opportunities



The manufacturing community at large has a basic knowledge of waterjet – the fact that it’s a cold cutting process and can cut almost anything. When faced with a tough manufacturing problem, they often seek out shops with waterjets to give the technology a try.

As a result, many of our customers tell us that a few months after installing their first waterjet, they start getting more work not only from their current customers but also additional projects from new customers.

To facilitate the spreading of the word, Flow helps new shops inform the local manufacturing community of their new waterjet. Flow provides a marketing resource kit, including hi-res photos, sample copy on waterjet attributes, and suggested end markets to pursue.

By adding waterjet capability, you can drive added business to your shop and get into new end markets that you did not serve before. For example, there are examples of fabrication shops that historically cut only metal finding work cutting large granite signs – for very high margin.

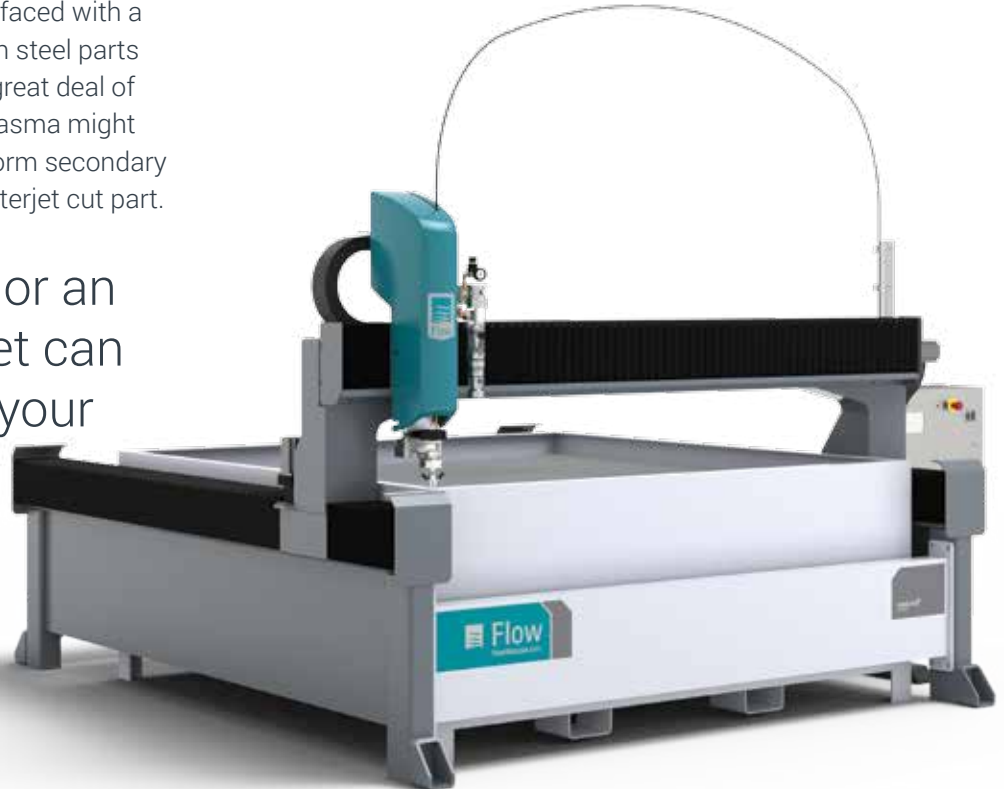
**#11**

Competitive advantage

Adding a waterjet system to your business can help you beat the competition and set you apart. For example, if you're a machine shop and are presented with an Inconel or titanium project you would normally cut on a mill, you can win the job with an aggressive quote that still provides a healthy margin thanks to your waterjet advantage.

Similarly, if you are a fabrication shop and you are faced with a job that will require a lot of hand grinding of carbon steel parts off a plasma machine, the waterjet often saves a great deal of total production time and cost, even though the plasma might cut the material faster. You will never have to perform secondary operations to remove heat affected zones on a waterjet cut part.

Whether you're a job shop or an in house operation, waterjet can be a beneficial addition to your equipment mix.





## Waterjets Are Environmentally Friendly

- 12. No hazardous waste
- 13. Quieter
- 14. Cleaner



# #12

No hazardous waste

Hazardous waste is a hidden cost that plagues many shops. Disposal is expensive, and improper disposal - whether intentional or not - can result in hefty fines and damage to our environment. Many cutting processes produce hazardous waste. The slag that drops to the bottom of the tank in plasma and some laser cutting is often full of heavy metals that leach out. Such byproducts of heat-based cutting require hazardous waste disposal. The vapors that rise from heat based cutting may need to be collected in a vapor extractor and scrubbed. Wire EDM (Electro Discharge Machining) usually requires hazardous dielectric to help conduct the electricity from the wire to the target material. Lubricants for machining can be hazardous, though there has been a welcome shift to more non-toxic lubricants.

None of these waste problems are an issue with a waterjet system.

Abrasive waterjet is tap water and inert garnet sand. Even though waterjet readily cuts potentially hazardous material such as high chrome stainless steels or high nickel alloy steels, the kerf width removed by the waterjet stream is so small that the parts per million of the tiny chips, as compared to the amount of garnet, are within safe discard limits. Since the waterjet is a cold cutting process, the material has not been altered, meaning the heavy metals will not leach out over time. No vapors or hazardous waste is generated, and the only waste product is primarily tap water – that can go down the drain when the sand has settled out – and sand residue ready to go to a clean landfill.

# #13

Quieter

For years, Flow's Mach Series shape cutting machine tools have had the capability of cutting under water. When cutting under water, the process is much quieter than many other cutting methods, emitting only a murmur down inside the catcher tank. The sound is not much louder than what you would hear filling up a bucket of water with a garden hose when the nozzle is submerged underwater. No cutting power is lost when cutting in this fashion.

The pump – usually a 25 to 100 horsepower unit – does generate noise but it can be silenced by placing the pump in another room or surrounding it with a sound-deadening package. Plasma and laser are not particularly loud machines, but the waterjet can be virtually silent. How quiet you want it to be depends on how you lay out and operate the equipment within your shop.



#14

Cleaner

# Today's waterjets can be a much cleaner, healthier process than most other cutting options.

It generates no vapors so there is no need to vent the exhaust. Cutting under water eliminates cutting sound, as described earlier, and most pierce spray. In addition, a pierce shield is located at the point the jet exits the cutting head, and splash shields placed on the outside of the material support catcher contain the remaining splashes. Some smaller envelope waterjet machines can be designed with full enclosures.

Cutting oils or emulsions requiring clean up are not required, another factor ensuring the cleanliness of the process. Basically, like all machine tools, the level of untidiness they create is determined by overall shop cleanliness practices. Milling machines running with the enclosure doors open can spray cutting lubricant and chips across a shop floor, and a waterjet can splash non-toxic and non-dangerous low velocity water and garnet grains as well. With proper operating processes, the milling machine and waterjet machine can run in a pristine facility.



Shop owners looking for a cutting solution have many alternatives from which to choose. Laser, plasma, milling, and router systems all have advantages that can be attractive. However, none of these alone offer the versatility, productivity, and flexibility at such an affordable price point as waterjet. When making a significant capital investment, it's in your best interest to select a system that will help both your top and bottom lines, and a waterjet solution is often best able to fulfill those goals.

After deciding to invest in a waterjet system, it's beneficial to work with an OEM who provides all pump models, head technologies, machine configurations, and price ranges to match equipment to needs.

As the world-leading waterjet machine tool supplier, Flow International Corporation offers the widest range of products to meet your waterjet cutting needs. We make small, entry level machines for simple production, higher end waterjets for intricate five axis cutting in high production running companies, and specialized equipment addressing unusual applications for companies such as Boeing composite wings and Kimberly-Clark disposable diapers.

Our application engineers are available to answer any questions or review your current manufacturing issues to see if waterjet might be right for you.

Please visit our website to learn more or to contact us for a test cut.

[FlowWaterjet.com](https://FlowWaterjet.com)