

Get the Most Out of Your Waterjet Cutting System

Eco-Friendly and Budget Friendly Tips for Increasing Waterjet Productivity

With time and money tighter than ever, waterjet shops around the world are looking for ways to maximize their waterjet systems' productivity and profitability without breaking the bank on capital investments.

Waterjet industry veterans Jeff Schibley and Bradley Schwartz of Jet Edge recently offered some helpful insights on how to increase waterjet productivity and minimize waste without breaking the bank.

According to Schibley and Schwartz, there are numerous ways to increase waterjet productivity, including X-Stream pressure pumps that can reach up to 90,000 psi (6200 bar), multiple-head systems that can include a dozen or more cutting heads, mirroring programs that can cut large parts twice as fast by using two cutting heads, and nesting software that can maximize parts per sheet or plate. Ancillary equipment also can be added to waterjet systems to increase their productivity, including abrasive removal systems, garnet recycling systems, chiller and closed loop systems, Dual Pressure Valves, height sensors and pneumatic drills.

All of these productivity enhancements serve an important dual purpose of increasing a waterjet shop's profitability and protecting our planet by minimizing material waste and water and power consumption.

X-Stream Pressure Pumps

For years, 60,000 psi (4100 bar) was the standard operating pressure for most waterjet shops, but in the last five years, X-Stream pressure cutting technology has made a dramatic entrance into the waterjet world. With pressures exceeding 90,000 psi, X-Stream pressure waterjets can increase cutting speed up to 50%, depending on the material. By cutting faster, X-Stream-powered systems use less power, water and abrasive, reducing operating costs as much as 40%.

"Increasing pressure is where we can see tremendous efficiencies in the abrasive waterjet cutting process," said Schibley, who serves as Jet Edge's Great Lakes regional manager. "By pressurizing to higher pressures, we get faster acceleration of the abrasive and we get more efficiency in the cutting process."

A great example is NASCAR's Michael Waltrip Racing (MWR). MWR has seen tremendous productivity gains since upgrading their waterjet intensifier pump to an X-Stream pressure pump. Since upgrading to X-Stream pressure, MWR has been able to reduce its waterjet operating hours from 60 to 65 hours per week to 40 to 50 hours per week, saving on labor and overhead.

"We've been seeing, across the board, a 35% improvement in cutting speed, plus we are using about 25% less garnet abrasive, and we have reduced our costs by 30%," said Nick Hughes, MWR's technical director.

"As an example, our spindles, which are one of our more complicated steering parts and cut from 2" 4140 steel, used to take 50-55 minutes to cut at 60,000 psi. Now we are cutting them in 30-44 minutes. Before we got the waterjet, it used to take three or four hours to rough cut them on a band saw. I also should note that about the same time we upgraded our pump, we changed suppliers for our spindle blanks. They use a much harder material that requires a slower cutting time. The X-Stream offset the increased cutting time.

"Another good example of a reduction in machining time would be our upper control arm plates that attach our front suspension arms to the chassis. These are cut from 1.5" thick steel and took about 1 hour and 25 minutes to cut two with the double heads and the old 60KSI pump. We can now cut two in about one hour with the double heads and the 90KSI pump."



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Get the Most Out of Your Waterjet Cutting System Continued... How Select the Right Waterjet Pump

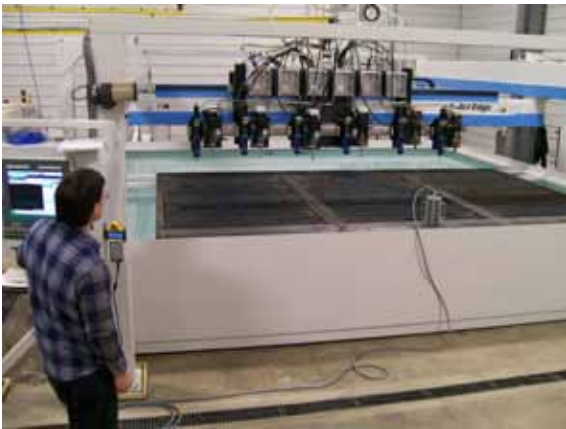
But how do you know if an X-Stream pressure pump is right for your shop, and how do you determine what horsepower of pump your shop needs?

Before investing in a waterjet system, ask the waterjet manufacturer to perform a test cut, Schibley advised. Most waterjet manufacturers provide free test cuts using material supplied by the customer.

The test will help you determine how many cutting heads are necessary to reach a desired throughput and how much horsepower is required to supply the proper amount of water to each cutting head. It also will determine the most efficient orifice/nozzle combination, pressure and abrasive feed rate for a given application.

"We cut the part to determine how much energy is required," Schibley noted. "As an example, you say, a .010/.030 orifice/nozzle combination at 60,000 psi made my part, but not as fast as I want. Well, I can run two .010/.030 nozzles with a 50hp pump or I can run four .010/.030 nozzles with a 100hp pump, or I can run six .010/.030 nozzles with a 150hp pump. If I'm cutting much over $\frac{3}{4}$ " thick material, I'm probably going to want to put a 50hp of energy into that nozzle. I'm going to run at least a .010/.030 at 75,000 psi (5200 bar) or a .015/.045 at 60,000 psi. Depending on the throughput is how we determine the horsepower, so if I run one head, I need 50hp, if I'm running two heads, I might need 100 hp, if I'm running three, I might want 150hp, if I'm running four, I might want 200 hp to feed the proper amount of water to that nozzle.

"We're trying to run as efficient a nozzle setup as we can. In a .010/.030 I can accelerate 0.6 pounds per minute of abrasive at 60,000 psi and I can accelerate 0.7 pounds per minute at 75,000 psi."



Multi-Head Systems

The quickest way to make a waterjet system more productive is to add multiple cutting heads to the system, Schibley noted.

"Look at most successful job shops and what are they running?" Schibley asked. "They are running two heads, three heads, four heads. That's generally because we burden a machine with overhead costs and general and administrative costs (G&A) based on that machine. We don't burden each cutting head, so when we start putting multiple heads on a machine it allows us to prorate our G&A costs over a greater number of parts per cut. So if I have \$50 per hour for G&A costs and I'm running one head and I've got \$37 per hour operating costs, I've got \$87 in costs and I haven't made a machine payment yet in operating that single head. Now if I go to two heads, what happens? If I have a 100hp pump and I'm operating two nozzles, I still have my \$37 to run each one of them, but my cost per part dropped by \$25 because I was able to prorate my overhead costs."

Mirroring – Cut Large Parts Twice as Fast

Adding optional mirroring capabilities to a waterjet system can be a huge time saver, said Schwartz, who serves as Jet Edge's Pacific regional manager. Mirroring capabilities allow waterjet operators to cut large parts simultaneously with two cutting heads, doubling productivity and freeing the machine and labor for other projects.

Precision Waterjet Concepts of Pequot Lakes, Minn., is one example of a shop that is saving time and money by mirroring parts with a Jet Edge Mid Rail Gantry system that also features programmable head spacing.

"We cut a lot of extremely large parts and we can save a lot of time and money by mirroring," said Joe Quaal, Precision Waterjet Concepts president. "Fifty percent of the time, we are mirroring. The programmable head spacing also saves us 10-15 minutes per job on set up time."

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Nesting Software – Maximizes Material

“A good nesting program is very important for any system, especially if you are looking at material that costs quite a lot and you’re doing high volume,” Schwartz said. “You can look at the efficiency of the nesting software and just conservatively see a 5% savings. Nesting will give you a huge amount of cost savings in a year.”

Nesting software saves money and increases productivity by maximizing the amount of parts that can be cut out of a piece of material. This reduces waste and minimizes the downtime during loading and unloading of parts. Nesting software can also be used to tab parts to prevent them from falling into the waterjet tank or to keep them together in a sheet of material so the entire sheet can be removed at once, speeding up loading and unloading.

Arro-Jet Engineering and Consulting of Camarillo, Calif., offered a dramatic example of how nesting can help shops save money and pass the savings on to customers.

One of Arro-Jet's customers needed to have parts cut from 20 84"X40" 3" thick titanium plates valued at \$50,000 a plate. The customer expected to get nine parts out of each plate, but Arro-Jet tightly nested the parts and cut 10 parts from each plate. The customer received 20 extra parts that they had not expected.



Pneumatic Drill

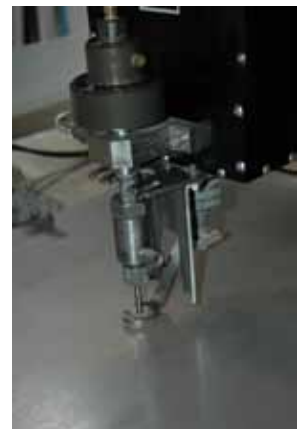
Pneumatic drills are an inexpensive accessory that can speed up waterjet processing time by pre-drilling material that is sensitive to delamination, such as polycarbonate or fiberglass, Schwartz explained.

The programming sequence will first run the drill, pre-drilling at desired locations, then switch to the waterjet to finish the part. This increases productivity by allowing waterjet operators to quickly pre-drill and cut sensitive material without using a slower low-pressure pierce or long lead in cut to the part. It also allows shops to cut materials that they may have avoided in the past due to delamination concerns.

Height Sensing

If you have ever had to shut down your system to replace a nozzle after slamming into uneven material or a tipped up part, you know why a contact height sensor is an invaluable waterjet accessory.

According to Schwartz, contact height sensors allow waterjet operators to overcome significant fluctuations in material flatness by maintaining a constant automatic standoff from the material. As a result, waterjet operators achieve optimum cut quality, tolerance, taper and speed without having to monitor the standoff. Height sensors also can be programmed to avoid previously cut parts that may have tipped up after being cut. Height sensors are also a necessity in running underwater cutting operations since the operator cannot monitor the “stand off distance” between the nozzle and material, Schwartz added.



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Dual Pressure Valves

For shops whose work requires them to frequently raise and lower pressure or do frequent low pressure pierces, Jet Edge's patented Dual Pressure Valve® offers a cost-effective solution to reducing wear and tear on pump components and reducing downtime.

"In dual pressure cutting, we want the ability to peck our way through material ever so gently with lower pressure water, and then as we get that hole in there, we can increase the pressure," Schibley explained. "In the case of glass, if I impact glass with 60,000 psi water, I'm going to get chips just like I'd get on my windshield when I'm driving behind a gravel truck and it throws a stone at me. It's going to take a big chunk out of it. I don't want to make that big chunk. I want to cut gently through there. Non-tempered glass cuts fine as long as we cut through from an edge, so we peck a tiny hole in there and now we can boost to high pressure.

"But when you take a waterjet pump and you ramp that pressure up and down, what occurs? Number one, when we ramp and load up and down on the electric motor it causes it to use more electricity. It also causes us to fatigue our high pressure components faster. High pressure components are designed to be at maximum pressure. They like being at 60,000 psi, or 75,000 psi, or 40,000 psi, whatever your system runs at. What they don't like is being at that pressure and suddenly being depressurized. It's that action that creates fatigue."

To overcome the wear and tear of dual pressure cutting, Jet Edge introduced a patented Dual Pressure Valve® that can be used with any waterjet system, Schibley explained. The valve allows waterjet operators to raise and lower water pressure independent of the waterjet pump.

"This allows us to reduce the pressure at the cutting head without having to ramp our pump up and down," Schibley explained. "So all the plumbing out to the cutting head gets to stay at what it likes to be at and what it's designed to be at, ultra-high pressure, and it reduces wear and tear."

Creative Edge Master Shop, Inc. of Fairfield, Iowa, has seen a tremendous increase in productivity and reduced maintenance costs and downtime since adding a Dual Pressure Valve.

The waterjet fabrication and design company runs nine waterjet systems more than 80 hours a week, cutting intricate pieces of mostly stone and tile for custom flooring designs that can be seen in fine homes, commercial buildings and civic institutions around the world.

The nature of such delicate cutting requires Creative Edge's waterjet operators to alter high-low water-pressure settings as many as 200 times a day, a process that can take 10 seconds per cycle and put tremendous strain on the intensifier pump that powers the waterjet, as well as the connecting high-pressure hoses.

"Ten seconds times 200 cycles per shift adds up to significant production gains, especially when you consider that we cut many small parts that may only take 30 seconds in actual profile cut time," said Mark McCabe, Creative Edge engineer. "If you're doing lots of high-low cycles, you are stressing every component. On one machine, I was replacing blown lines every week. Every week, I would have a leak somewhere and would have to spend \$200 an hour for maintenance."

Since installing the Jet Edge Dual Pressure Valve, McCabe has not had to service the offending intensifier pump, and has increased productivity by eliminating downtime between high-low cycles.

"That Dual Pressure Valve is amazing," he said. "It has just been a trooper. Nobody else has anything comparable on the market. It saves wear and tear on all the components."



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Green Accessories – Closed Loop Filtration and Garnet Recycling

Waterjet has always been considered an eco-friendly technology, but it's becoming even greener as more shops invest in green accessories that are not only good for the environment, but also good for their bottom line.

Closed-loop filtration systems are perhaps the greenest of all waterjet accessories. They allow waterjet shops to filter, cool and recycle water, eliminating the need to dump it down the drain. A must in desert environments, closed-loop filtration systems are now required by many municipalities and for ISO-9000 certification. They also provide a great option for waterjet shops that do not have a floor drain.

"When I have a closed loop filtration system and chiller, I am taking the water after the cutting process, giving it a three-stage cleaning and providing a filtration level of 50 parts per million, total dissolved solids," Schwartz explained. "I'm chilling the water as well and providing that back to the cutting loop of the pump, re-pressurizing it and completing the loop. Reusing the water and zero discharge to the environment is what it's all about."

Many waterjet shops are insisting on closed-loop filtration for environmental reasons. Among them is Twelve Strike Bowling Services of Long Beach, Calif.

"We are in the desert here and water is a huge issue," explained Twelve Strike's owner Ron Richmond. "I also did not want to be dumping water down the drain. I do not have an environmental issue here and I do not want one."

Precision Waterjet Concepts has devised an ingenious system that uses their waterjet chiller to heat their Northern Minnesota waterjet shop with hot water generated by its five waterjet systems. Winters in Minnesota can get very cold, so this has resulted in tremendous savings on their heating bill.

Garnet is by far the costliest operational expense of a waterjet system. Abrasive waterjets go through 0.5 to 1.5 pounds (0.25 to 0.68 Kg) per minute of the abrasive material, which can cost 20 cents to more than 40 cents per pound, depending on grade. The good news is, garnet can be effectively recycled.

Garnett Gerke of G.O. H2O of Edmonton, Alberta, Canada, uses a garnet abrasive recycling system to reclaim 50-70 percent of his garnet. He mixes used garnet with new garnet and has seen no reduction in cutting speed. He recovered the cost of his recycling system in one year and now uses it to recycle abrasive from two waterjet machines.

Gerke explained that he had to come up with a way to remove the garnet from his tank and reuse it to minimize downtime for shoveling out the tank and reduce disposal costs.

"In our first two years [cutting 24/7], we had had to shut down every seven to 10 days to clean out the tank," Gerke recalled. "We would be down 8-12 hours. We had a sump truck come in and pump out the tank and haul the garnet off to the landfill. The first year, he charged \$400 per visit. Two years later, it was three times the cost."

If you have high disposal costs in your area, it can definitely be worth it to recycle the material, Schwartz noted.

"Only about 30% of the abrasive is actually doing the work and the rest is going right into your tank," Schwartz explained. "You can reclaim this."



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Abrasive Removal Systems – Stop Shoveling!

Abrasive removal systems are a must for high-volume shops. They all but eliminate the need to shut down production to shovel out a tank. Shops with an abrasive removal system might only have to shovel their tank out once a year to remove large material drops, versus several times a month if they do not have an abrasive removal system and run 24/7.

“Abrasive removal systems will allow for 24-hour operation seven days a week by pulling the abrasive out of the tank and discharging it into a receptacle,” Schwartz explained. “It keeps the tank stirred up and keeps the abrasive suspended and in the water and will bring it out through a centrifugal separator and discharge into a tank and into a bag filter. When that fills up, you just pull the full bag out and put an empty bag in.”

Abrasive removal systems can be added to existing waterjet systems.



But Most Importantly, Maintain Your System



You can equip your waterjet shop with all the latest productivity accessories and the biggest pump on the market, but if you do not maintain your waterjet system properly, your productivity could suddenly drop to zero. The most important thing you can do to maximize productivity is to maintain your system properly.

“I had a customer who never changed their hydraulic oil or hydraulic filter,” Schibley recalled. “They had over 4,000 hours on the original hydraulic fluid and all of a sudden, their pump said ‘I don’t want to run today.’ The hydraulic oil broke down over a period of time and it gummed up the directional control valve. Had they been changing their filters regularly and changing their hydraulic oil as recommended, they would not have had hydraulic oil breakdown and a clogged directional control valve which stopped the process from working.”

“Maintenance is important. All high pressure waterjet systems require maintenance. It’s just the nature of the animal. The more we maintain that pump and do what the manufacturer recommends, the lower the cost of operation becomes. You hear some people complain about how high the cost of maintenance is; well ultra-high pressure only becomes high maintenance if you neglect it. If you allow a weep hole to continue weeping water out until it cuts a groove in that high pressure component, now you have to spend a lot of time lapping it out or you have to replace that component. In order to minimize the cost of ownership and minimize the maintenance and downtime, proper maintenance is tremendously important. That is why Jet Edge offers free training for the life of your machine. We want you to be trained and we want you to know how to operate your system properly and in turn you’re going to get the greatest life out of your components.”

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