

# expertise in waterjet cutting

## Waterjet cutting

An alternative production technology

**Bystronic**

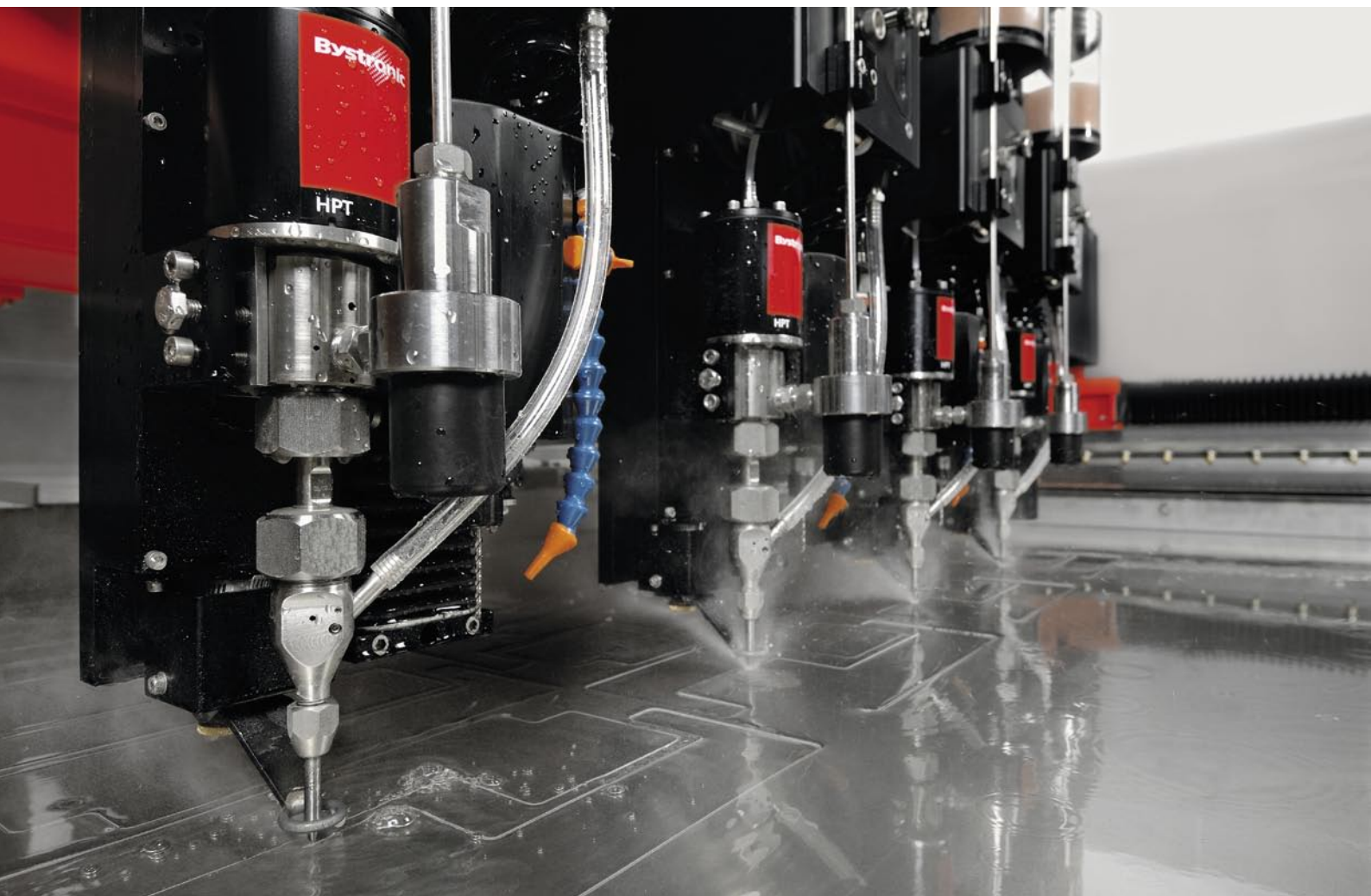
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For additional information about waterjet cutting, please visit Bystronic on the Internet at [www.waterjet.bystronic.com](http://www.waterjet.bystronic.com)

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# Waterjet cutting – an alternative production technology

The triumphal procession of waterjet cutting continues. An increasing number of companies are discovering the nearly unlimited possibilities of this efficient and extremely economical process, which is also often used to supplement mechanical processing. High-pressure waterjet cutting with or without an abrasive additive is being used by contract manufacturers in nearly every industry today: from aerospace to the textile and food industries, and increasingly also in industries that process glass and composite materials.

Waterjet cutting is the ideal complement to milling or other common cutting processes. Depending on the requirements with respect to the quality and precision of the parts to be processed, waterjet cutting can be used for preprocessing. It may also be possible to replace milling or another conventional form of processing with waterjet cutting. Even high-tech materials such as carbon fiber and other composite materials can be processed efficiently and precisely with waterjet cutting. Material consumption is thus reduced due to the minimal waste.

## **The benefits of waterjet cutting speak for themselves:**

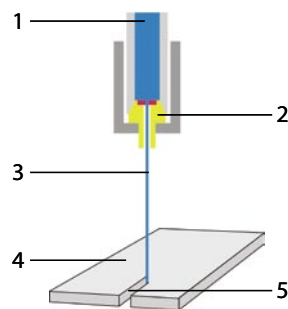
- Nearly all materials can be processed in various thicknesses. The low cutting and reaction forces permit the processing of soft and pliable materials (e.g. foams) as well as the production of filigree structures.
- There is practically no thermal loading of the material, and the changes in the material structure are minimal.
- During the cutting process, material removed from the cut width (kerf) is bound in the cutting water.
- The narrow cut width (kerf) enables material-saving cutting.
- Cutting can take place forward and backward, and therefore nearly any contours can be created.
- Various cutting qualities in a single clamping and with just one cutting tool enable very efficient work with the water jet.



Bystronic systems impress not just with their great precision, but also with their useful life, which is unique on the market.

# Technology and economic efficiency

The essential parameters of waterjet technology are the pressure and the water throughput. These two parameters produce the jet energy. The water is brought to a particular pressure with the pressure generator. The jet is generated in the cutting head, where the pressure energy is transformed into kinetic energy. Depending on the application, an abrasive is fed into the jet using a dosing system. The interaction between the jet and the workpiece produces the processing result.

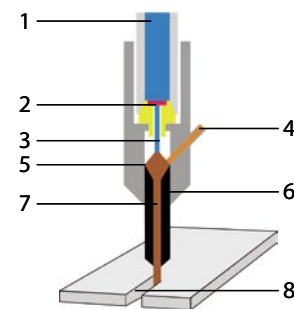


## Schematic depiction of pure-water waterjet cutting

- 1 Water under pressure
- 2 Water nozzle
- 3 Pure water jet
- 4 Work piece
- 5 Cut width (kerf)

### Pure-water waterjet cutting

Water compressed at very high pressure is released through a narrow opening, the so-called water nozzle or sapphire nozzle. It forms a water jet, which comes out at a speed of up to 850 m/s. Soft materials such as seals, foams, and rubber can be cut perfectly with this water jet.

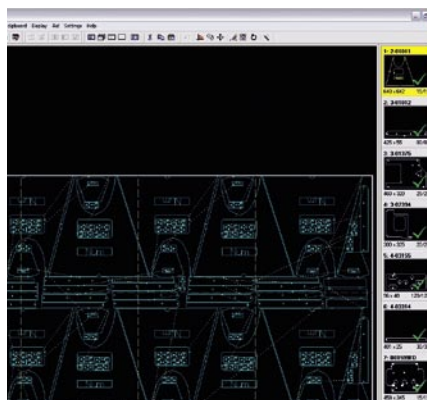


## Schematic depiction of waterjet cutting with an abrasive

- 1 Water under pressure
- 2 Water nozzle
- 3 Water jet
- 4 Abrasive feed (unpressurized)
- 5 Mixing chamber (vacuum chamber)
- 6 Abrasive nozzle (focusing tube)
- 7 Water jet with abrasive
- 8 Cut width (kerf)

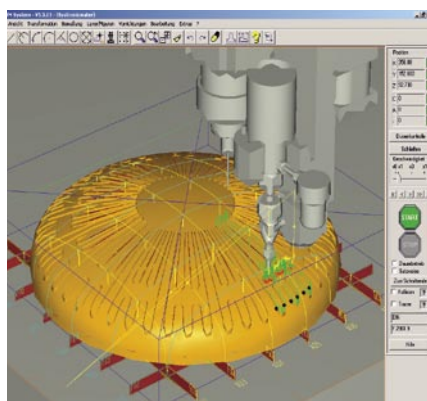
### Abrasive waterjet cutting

For waterjet cutting with an abrasive, a cutting medium, the so-called abrasive (garnet sand, for example) is added to the water jet in a mixing chamber. In a second nozzle, called the focus nozzle or focusing tube, the water jet with abrasive is focused and the abrasive particles are accelerated to a high speed. They move fast enough in order to cut even very hard materials.



**A technology that redefines economic efficiency – cost-effective production of prototypes and small series**

A CAD file (in all common formats) of the part to be created is read in for the waterjet cutting process or created directly in the user software. The cutting plan specifies the cutting parameters for the various sections of the contour, including feed motion speed and pressure. The material to be processed is positioned on the system and cutting can begin. Thus, waterjet cutting impresses with extremely short programming and setup times as well as efficient cutting times. Waterjet cutting systems can be equipped with several cutting heads, and if necessary, several parts can be produced at the same time. Waterjet cutting systems provide users with previously unknown flexibility and economic efficiency. From individual and prototype production to small series on through to large series, all orders can be produced cost-effectively and fast, and this with a nearly unlimited range of materials. Furthermore, since waterjet cutting is a “cold” cutting process, the material is not subject to any thermal or processing forces.



**3-axis CAD/CAM**

The 3-axis CAD/CAM allows the cost-effective production of simple three-dimensional shaped parts. The clamping fixture required for this is constructed automatically by the software and can be produced using the same waterjet cutting system.

# Process comparison and savings potential

## **Plasma or fine plasma cutting**

If the parts require no mechanical post-processing, for example, because they only need to be welded or because they are simple parts, plasma cutting is more cost-effective. If the parts do require post-processing, or if aluminum or other materials are used that are not especially well suited to plasma cutting, then waterjet cutting is usually the more cost-effective option.

## **Wire eroding**

Wire eroding is often used for parts that can only be produced with difficulty using mechanical processing (e.g. due to filigreed contours or clamping or processing forces that are too high with mechanical production). If the high precision or surface quality of wire eroding is not crucial, waterjet cutting can be used to produce parts much more cost-effectively. Here a cost analysis is almost always worthwhile.

## **Mechanical processing**

For waterjet cutting, the cutting is done solely by the water jet, which is an advantage compared with mechanical processes that wear down the tool, e.g. milling. The material costs are significantly lower due to the narrow cut with (kerf), the possibility of nesting, and the low waste. In addition, no complicated clamping fixtures are required. Productivity can be increased further with waterjet systems with several cutting heads working in parallel.

## **Laser cutting**

If the parts will be welded or bent after cutting, if no post-processing is required or if they are simple parts, then laser cutting produces the greatest cost savings when processing mild steel and rust-resistant steel. By contrast, waterjet cutting has the advantage that nearly all materials can be cut, even at very great thicknesses. The waterjet cutting process also enables great precision.

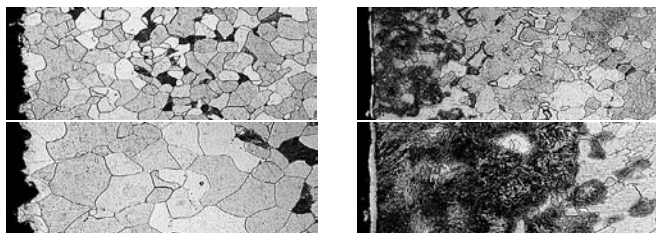
## **Flame cutting**

The rule is: if the cutting edge quality of flame cutting fulfills the requirements, then flame cutting is more cost-effective than waterjet cutting. Waterjet cutting provides benefits with respect to the surface, because depending on the process there are no weld spatters and essentially no burr formation. The parts can also be processed further without thermal heat treatment and straightening.

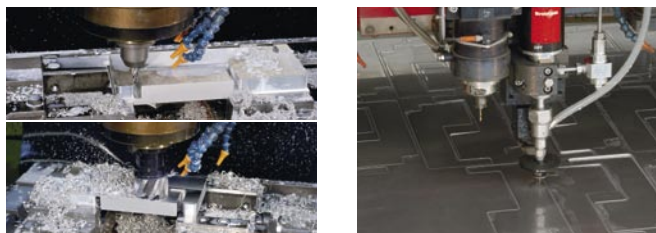
20 mm mild steel, cut with the water jet with abrasive (left) and the laser jet (right): comparison of the component surfaces and structure analysis.



Because waterjet cutting is a cold process, there is no structural influence. The heat transfer during laser, plasma, and flame cutting changes the structure.



High material loss with milling. With waterjet cutting, the parts can be nested, which reduces costs enormously.



	Waterjet cutting with abrasive	Laser cutting	Plasma cutting	Flame cutting
Material thickness	++	-	+	++
Cutting quality	++	++	-	-
Cutting speed	+	++	+	+
Universal utilization	++	-	+	-
Precision cutting	++	++	+	-
Post-processing	++	++	+	-
Slagging	+	-	-	+
Flexibility	++	+	-	-
Total processing time	+	++	-	-





Material:	Stainless steel
Thickness:	15 mm
Cutting quality:	Very high
Cutting time:	6 minutes 31 seconds
Special features:	Engraving

However, the same material cut with a lower cutting quality (separation cut).

Cutting time: 1 minute 41 seconds



Material:	Aluminum
Thickness:	30 mm
Cutting quality:	High
Cutting time:	47 minutes 15 seconds
Special features:	Very high shape precision



Material:	Alu compound
Thickness:	6 mm
Cutting quality:	High
Cutting time:	3 minutes 16 seconds
Special features:	High shape precision



Material:	Short-fiber-reinforced plastic
Thickness:	20 mm
Cutting quality:	High
Cutting time:	1 minute 55 seconds
Special features:	High surface quality



Material:	Tool steel
Thickness:	60 mm
Cutting quality:	High
Cutting time:	77 minutes
Special features:	No tolerance deviations, no heat deformation, and no hardness increase

The cutting times are based on a single cutting head machine. If a four cutting head machine is used, the production time reduces to one quarter.

# The efficiency makers – waterjet cutting machines from Bystronic

## ByJet Pro

The ByJet Pro impresses with its ergonomic and safe operating concept thanks to encapsulation and the safety gate as well as a low-noise work environment. The shuttle table is another highlight which contributes to the outstanding productivity of the system.



## ByJet Pro L

The ByJet Pro L is available with a working area of up to 3 x 16 meters; it is thus suited for very large material sheets and round parts up to 7.7 meters.



	ByJet Pro 3015	ByJet Pro L 2030 to 16030*
Cutting heads	1, 2, 4	1, 2, 4
Maximum positioning speed parallel to the axis	60 m/min	60 m/min
Positioning accuracy	± 0.08 mm /axis	± 0.05 mm /m
Repeatability	± 0.025 mm /axis	± 0.025 mm /axis
Cutting range for flat processing	3048 x 1524 mm	2048 x 3068 mm up to 16 048 x 3068 mm
Maximum workpiece weight flat part	up to 790 kg/m <sup>2</sup>	up to 790 kg/m <sup>2</sup>
Maximum workpiece thickness	200 mm	200 mm

\* ByJet Pro L 2030, 4030, 6030, 8030, 10030, 12030, 14030, 16030



## ByJet Classic

A waterproof investment! ByJet Classic was developed for users who expect high functionality and precise cutting results and, at the same time, value an attractive price.



## ByJet Classic L

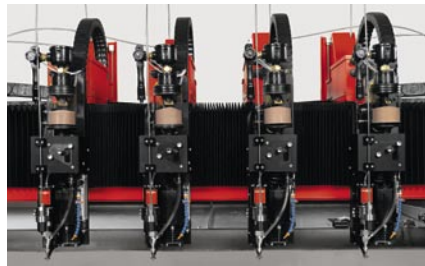
Extraordinary parts produced at an affordable price: The ByJet Classic L cuts large and special formats simply and without difficulty. A safe investment even with XXL formats!

	ByJet Classic 3015	ByJet Classic L 2030 to 10030*
Cutting heads	1, 2	1, 2
Maximum positioning speed parallel to the axis	60 m/min	60 m/min
Positioning accuracy	± 0.08 mm /axis	± 0.05 mm /m
Repeatability	± 0.025 mm /axis	± 0,025 mm /axis
Cutting range for flat processing	3048 x 1524 mm	2074 x 3068 mm up to 10 074 x 3068 mm
Maximum workpiece weight flat part	up to 790 kg/m <sup>2</sup>	up to 790 kg/m <sup>2</sup>
Maximum workpiece thickness	200 mm	200 mm

\* ByJet Classic L 2030, 4030, 6030, 8030, 10030

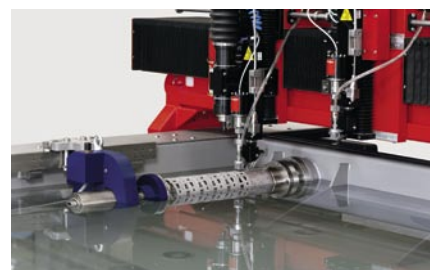
### Cutting bridge

The cutting bridge with integrated tool axes and cutting head distinguishes itself through its great precision. Powerful height sensing with integrated collision protection and automatic nozzle calibration guarantees this. These features also ensure low-maintenance operation. With a drill spindle it is possible to pre-drill expensive fiber composites and other materials, which effectively prevents damage to the part (delamination, cracking).



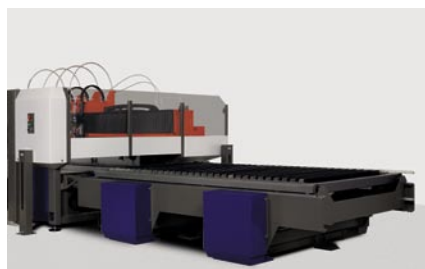
### Rotary axis

Depending on how the machine is equipped, round and profile tubes can be processed fast and economically using the optional CNC-controlled rotary axis. The unit is integrated into the front part of the machine basin and thus easily accessible to the operator.



### Shuttle table

The ByJet Pro can be equipped with an optional shuttle table system. Its ergonomic design enables comfortable and safe access to the cut parts, which are cleaned automatically during the table change. Non productive times are also reduced this way.



### High-pressure pump Bypump 50 APC (Active Pressure Control)

Two individually-driven pressure intensifiers regulated by a micro-processor guarantee constant, linear and infinitely adjustable pressure. There is no need for an accumulator that would be subject to inspection. The intelligent and extensive diagnostic system also ensures fast and efficient maintenance and trouble-free operation of the pump for many years.



Bystronic is a worldwide active supplier of application-oriented systems and services for the laser and waterjet cutting processes, as well as bending: economical, high-performance, reliable.



**Laser cutting**  
Laser cutting systems for the innovative processing of a wide variety of materials and geometries



**Bending**  
3-point and air bending machines for high-precision working of sheet metals



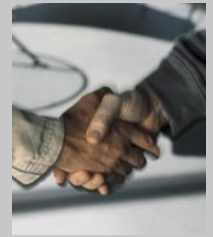
**Waterjet cutting**  
Waterjet cutting systems for cutting metals, glass, synthetics, ceramic, and many other materials



**Automation**  
High-performance handling and automation solutions from simple loading systems to fully automated laser production cell with integrated storage system



**Software & Control**  
User-friendly programming and operation with requirement-oriented application programs and interfaces to CAD and ERP systems



**Service & Support**  
Competence and customer proximity with after-sales support available worldwide: local contact persons, prompt delivery of spare parts, and professional training courses

## Your contact

[www.bystronic.com](http://www.bystronic.com)