

*THE*

# ACCELERATION EFFECT

The Key to Productivity &  
Efficiency in Waterjet Cutting



**IN OCTOBER OF 1997**, Andy Green drove his Thrust SSC car on a one-mile track in the Black Rock Desert to set the current official world land-speed record of 763 miles per hour. In February of 2019, Denny Hamlin, of Joe Gibbs Racing, reached a top speed of just over 191 miles per hour in winning the Daytona 500.

Using simple math, you might conclude that Green and his Thrust SSC could have easily won at Daytona since he reached a top speed almost four times as fast as Hamlin, right? Obviously, it's not that simple. Where Green had a short, straight line track, Hamlin had to negotiate a series of short tight turns and straightaways in his 200 laps around the world famous Daytona International Speedway oval.

You may be wondering, what does auto racing have to do with waterjet cutting?

***EVERYTHING.***





For years, waterjet manufacturers have been using raw cutting speed defined in inches cut per minute as a measure to compare different machines. Traditionally, a waterjet that cuts 700 inches per minute was considered superior to one that cut 500 inches per minute. But there's rarely been a mention about how long it takes to get to that top speed.

**IN REAL WORLD APPLICATIONS,** most shops rarely have the need to cut 700 inches in a straight line – like Andy Green's straight-ahead track. Most waterjet machines need to cut shapes which require constant starting and stopping to navigate multiple curves, straightaways, and heavy traffic - like Hamlin at Daytona.





When choosing a waterjet cutting system, **your primary concern should be the total time it takes** to complete your projects.

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The primary aim of a waterjet cutting system is to improve productivity and efficiency and ultimately increase profitability. Straight-line machine speed alone doesn't reveal the most productive waterjet. It's time to change the conversation and focus on acceleration – not pure speed – as the best way to reach those goals.





## What's the difference between ***acceleration*** and ***speed***?

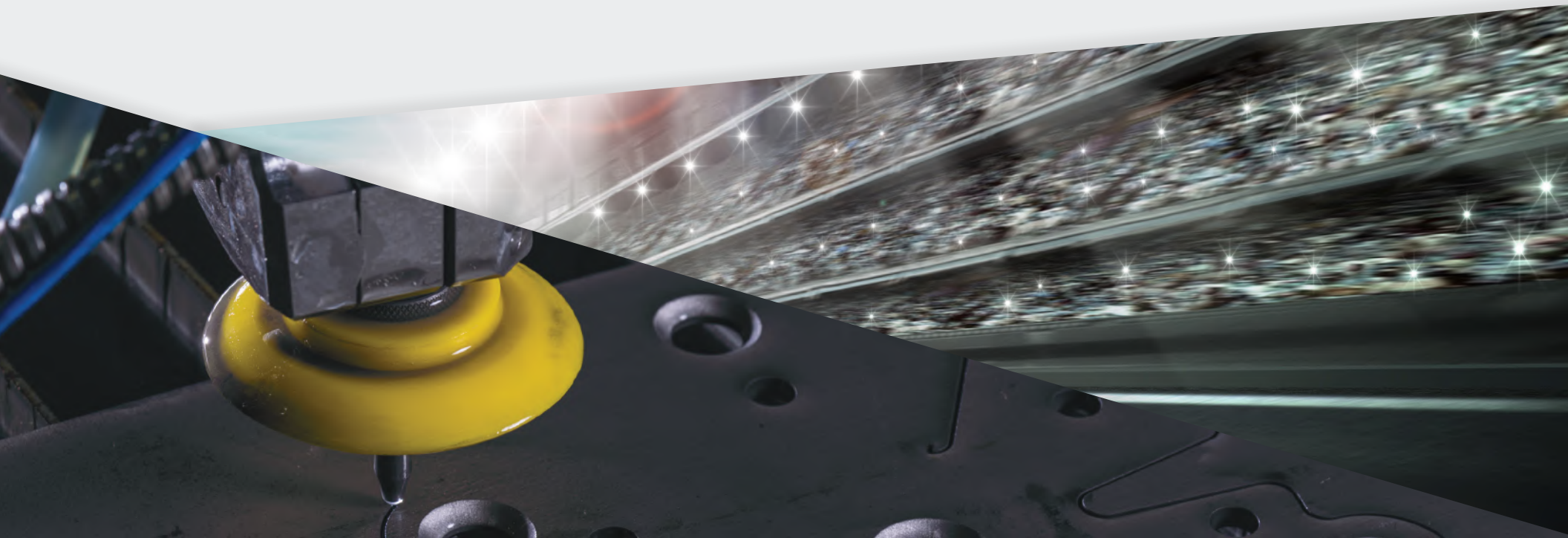
When it comes to waterjet cutting, **SPEED** is typically defined as the maximum amount of distance that the machine can travel over a given period. While it is true that such a measurement provides you with the raw speed of the machine, what's more important, as we saw in our car racing analogy, is how quickly a machine can reach that top speed.

There's no question that you should consider machine speed when choosing a waterjet, but keep in mind that not every project will involve a four-foot long straight cut. In fact, in the typical job shop, very few of your cuts will fit that description. Most will involve navigating the geometry of going into and coming out of corners and curves. This means the machine will be continually starting and stopping throughout the process. That's where acceleration becomes more important than raw speed.

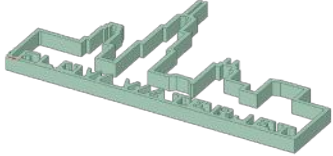








**ACCELERATION** in waterjet cutting is defined as the change in speed over a period of time – how quickly the machine can go from a sitting stop to full speed then back down to a full stop. It is accurate that a machine touted as cutting 700 inches per minute can move at that rate. While cutting with an abrasive waterjet, however, the machine will rarely - if ever - cut at 700 inches per minute. In the end, the top speed number is of very little value when comparing the effectiveness of various waterjet machines.

A much more relevant number is the acceleration rate. In the automotive industry, the common acceleration metric is the time it takes to get from 0 to 60 mph. In waterjet cutting, the metric most often used is the gravity or g-rating. The typical g-rating range for most waterjet machines today is 0.02g to 0.05g. Some of the more advanced machines, like those from Flow Waterjet, operate at a 0.1 g-rate – nearly two to four times faster acceleration than typical waterjet systems.

Acceleration is crucial in a job shop where most cuts require the waterjet to constantly accelerate and decelerate as it hits tight radius turns or in the case of square cut, nearly comes to a complete stop. The cutting head is moving between those low and maximum speeds around the part where acceleration and deceleration can make the most time-saving impact.



# *Acceleration* drives productivity.

Test Cut <small>* for 1/4" thick aluminum measuring part cycle time</small>	Legacy & Other Waterjet Systems	Mach 500	Results
	181 SECONDS	 <b>149</b> SECONDS	 <b>17.7%</b> FASTER
	430 SECONDS	 <b>294</b> SECONDS	 <b>31.1%</b> FASTER
	155 SECONDS	 <b>124</b> SECONDS	 <b>20.0%</b> FASTER

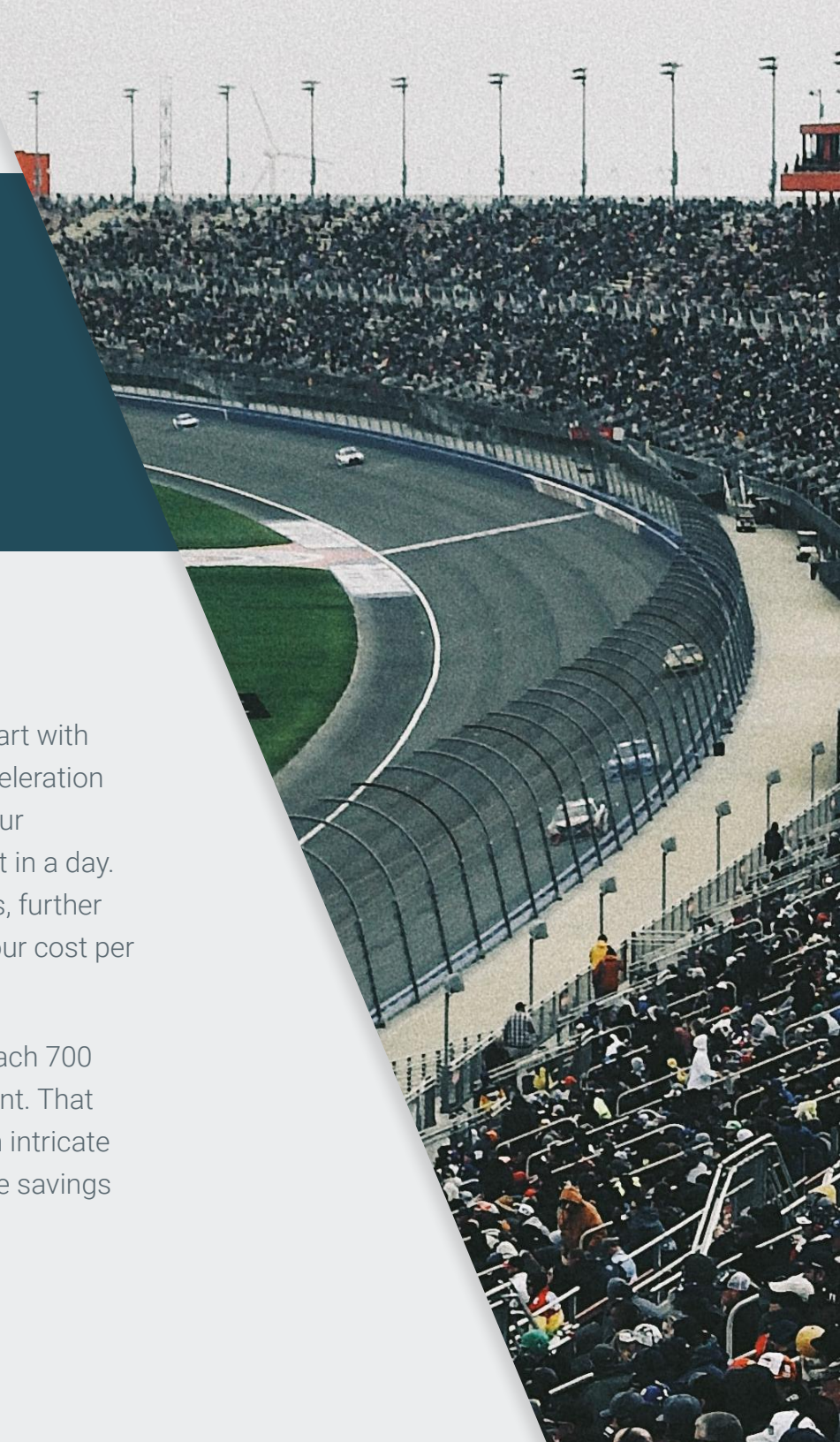
**SUMMARY** Part cycle time is **REDUCED UP TO 30%** by Mach 500.  
Mach 500 acceleration/deceleration is **2X GREATER** than legacy systems.



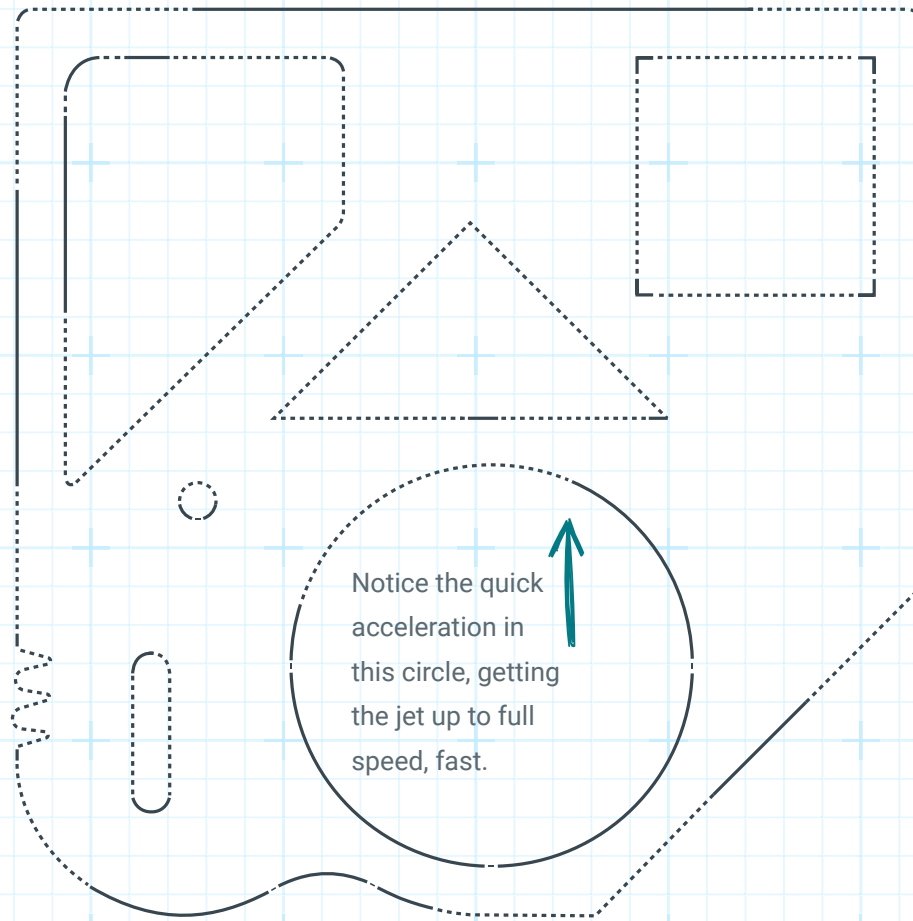
# The Benefits of ***Faster Acceleration***

The primary goal of any shop is to reduce the time it takes to cut a part with a waterjet machine which results in a lower cost per part. Faster acceleration helps you get parts on and off the machine quicker and increases your productivity. It also boosts the number of parts your machine can cut in a day. Faster, more efficient cutting also decreases the use of consumables, further reducing the overall cost of your machine. That efficiency reduces your cost per part and makes you more competitive in your market.

In comparisons to other waterjet machines, Flow's Mach 500 and Mach 700 were able to decrease cutting time by an average of almost 20 percent. That means 20 percent less water, abrasive, and other consumables. With intricate parts where the machine needs to stop and start more frequently, the savings are even greater.







Notice how quickly  
the jet accelerates  
to full speed.

Notice the quick  
acceleration in  
this circle, getting  
the jet up to full  
speed, fast.

..... Jet is accelerating  
or decelerating

———— Jet is at full speed

**WATERJET PARTS** are generally made up of diverse geometry, therefore you rarely find yourself cutting at top speed. This sample part visually demonstrates why a fast acceleration and deceleration speed is important to your overall cut part productivity.



You can **take advantage of this increased productivity** by passing on the savings to your customers and winning more business, or let it drop to the bottom line to **increase your profit margin.**

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In the end, the top maximum speed and the rate of acceleration determine how quickly you can cut a part. Since most of your projects do not involve long, straight cuts, acceleration becomes the most important part of that equation.





## The Flow Advantage | **Mach 500 + Mach 700**

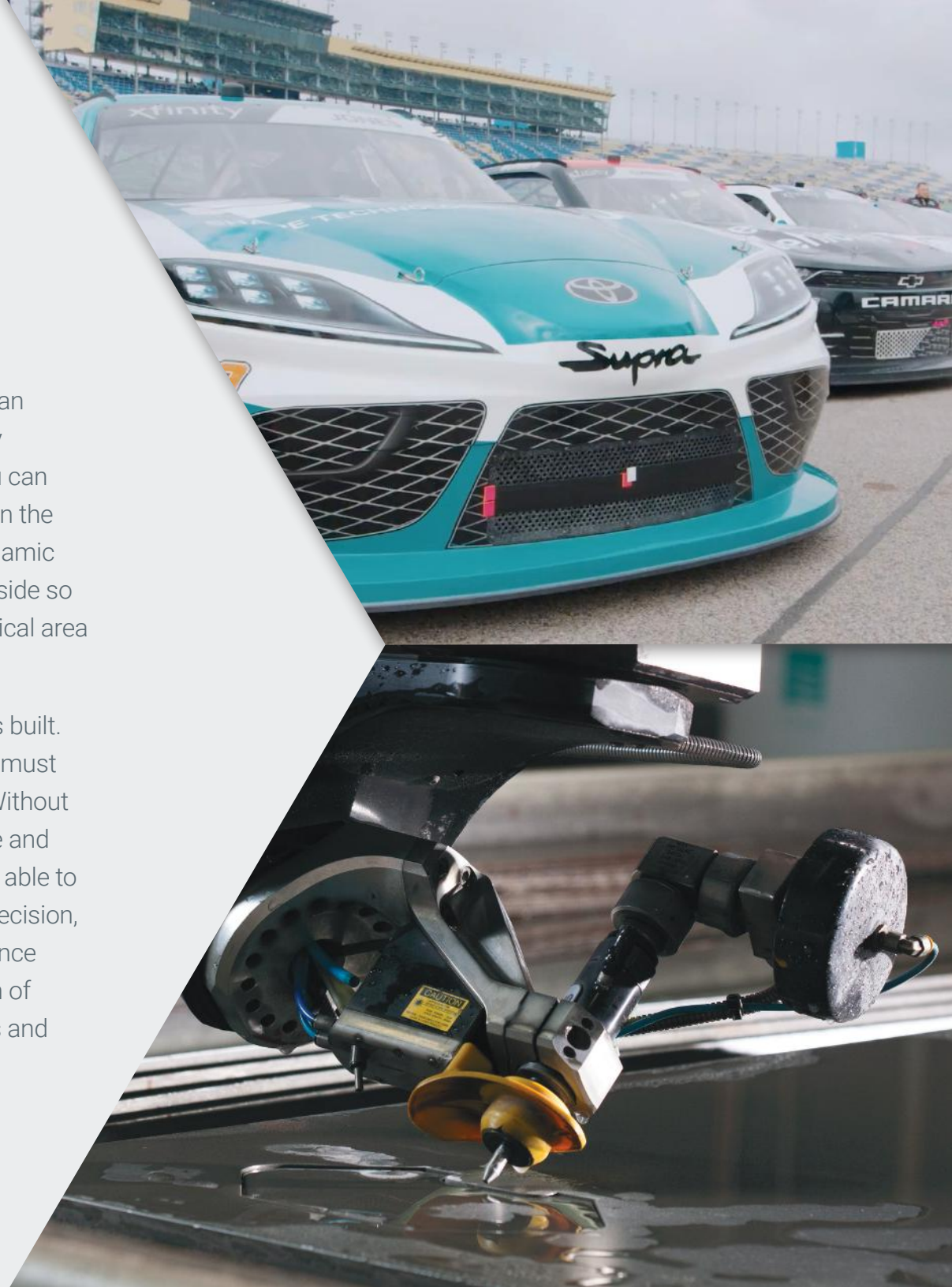
Flow Waterjet understands the benefits of acceleration better than most companies in the industry. The Flow Mach 500 and Mach 700 waterjet machines were designed and built from the ground up to be able to offer the fastest acceleration currently available. That translates to faster total cutting times and increased productivity for your shop.

The Mach 500 and Mach 700 machines are capable of acceleration speeds of .1g, more than double what you might find in other waterjet systems. This is a dramatic improvement in acceleration that significantly reduces the time to cut intricate parts that require constant starting and stopping of the machine.



There are several ways to reduce cutting time. You can increase the pump pressure which Flow has done by offering machines with pressures up to 94K PSI. You can compensate for taper so you don't have to slow down the machine. Flow has addressed that issue with its Dynamic Waterjet® that automatically angles the head to one side so that all the taper goes to the scrap side. The next logical area is acceleration.

The acceleration speed is set on a waterjet when it is built. The g-rating can be set at any level, but the machine must be built to withstand the rigors of a higher g-rating. Without the proper structural integrity, the machine will shake and rattle and produce a jagged cut since it would not be able to maintain a rigid location. The machine would lose precision, accuracy, and quality. It would also be less reliable since there would be increased downtime and degradation of parts. The overall impact would be poor quality parts and a dramatic reduction in the life of the equipment.







Just as Joe Gibbs Racing is always looking at technology advances to **improve overall speed** on the racetrack, Flow is always seeking to find ways to create more efficiency and productivity through **greater acceleration.**

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They factored in robotics, steel construction, software and pump pressure to design a heavy-duty piece of equipment capable of handling a 0.1g acceleration level.



The construction of the **MACH 500** and **MACH 700** gantry is rigidly built out of steel construction with proper engineering that can structurally handle the force of increased acceleration. Flow used premium, quality machine tool components including industry-leading rails and bearings, drives, and closed loop encoders. The design called for spinning the nut and not the screw, another Flow innovation.

The combination of advanced hardware and software, innovative engineering, detailed research, and Flow's years of experience and expertise resulted in a series of machines that can achieve high straight line cutting speed and top acceleration levels needed to reduce overall cutting time in real-world settings. Designing and building a machine that can produce the highest levels of acceleration while still maintaining cutting quality required a dedicated effort from the entire Flow team.







Straight line cutting speed can be an enticing metric when evaluating waterjet machines. While it is important, it is only one factor and one that is often not relevant to real-world cutting projects. When handling multiple cutting jobs with intricate designs and many corners and curves, it's much more important that the machine is able to accelerate quickly to get in and out of those corners.

The key measurement that should guide you in your decision-making process is over all cutting time just as straight line speed alone doesn't lead to more wins on the racing circuit. You want a piece of equipment that allows you to get projects on and off your waterjet as quickly as possible. That is what will ensure you remain competitive and profitable.

Having a machine with superior

***ACCELERATION***

is the most effective way to reach goals.



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