Perfect Laser Technologies

TECHNICAL BULLETIN # 7

Waterjet Basics

A waterjet uses a high pressure stream of water for cutting materials. Ordinary tap water is pressurised up to 60 000 psi (around 4130 bar) and forced through a very small hole. If you then mix the water with garnet abrasive, you have a very thin stream of abrasive water - traveling very fast - that will rapidly erode most materials.

To cut softer materials such as thin plastic, rubber and foam, you don't need the abrasive - just water. Waterjets can cut just about any material in sheet form. The most popular materials are metals - because waterjets can cut intricate shapes to a high precision quickly and economically.

Waterjets also commonly cut stone and glass, because the waterjet can cut intricate shapes not possible using traditional machining methods. Among the very few materials that waterjets cannot cut are diamonds and tempered glass. Diamonds are too hard to cut, and tempered glass will shatter - as it was designed to do.

A few composite materials also can't be cut because the water can get between the layers and delaminate the material. Many composite materials cut fine though, and there are some special techniques to cutting laminated materials.

Waterjets are fast, flexible, reasonably precise, and in the last few years have become more user-friendly and easy to use. The use of high-pressure water being forced through a small hole to concentrate an extreme amount of energy in a small area creates a high-velocity stream, much like putting your finger over the end of a garden hose - except traveling close to the speed of sound, at about 960 kilometers an hour.

A waterjet is a versatile and flexible machining tool. You can cut a wide variety of material efficiently and cost-effectively and can create a wide variety of parts. Some of the materials that can be cut include : copper, brass, aluminum, pre-hardened steel, mild steel, titanium, stainless steel, glass, ceramic, quartz, stone, laminates and most flammable materials.

With waterjet machining, a flat piece of material is placed on the cutting surface, and a cutting head moves across the material. This simplicity means that it's fast and easy to change materials and that no tool changes are required. All materials use the same cutting head, so there is no need to program tool changes or physically change multiple tools.

The movement of the machining head is controlled by a computer. In most cases, a CAD program is used to draw the part. When you start the job, the part is made by the waterjet. This also means that customers can create their own drawings and bring them to a waterjet operator / owner for creation.

There are very low sideways forces, so cutting the material doesn't move it around. The downward forces are also small - in the range of a few grams. Typically, the largest force is from the water in the tank pushing back up against the material.

Perfect Laser Technologies (Pty) Ltd
Unit 6, 451 Vale Ave, Randburg.
Tel: 010 157 0112
www.perfectlaser.co.za
sales1@perfectlaser.co.za

June 2017

Fixturing is generally achieved by placing weights on the material. This also allows for close nesting of parts, and maximum material usage. Small parts, however, may require tabs to prevent them from falling into the water tank. The low sideways forces mean that you can cut an item as thin as 0.25 mm.

What little heat is generated by friction is absorbed by the water and carried into the catch tank. The material itself experiences almost no change in temperature. The result is that there is no HAZ (Heat Affected Zone) on the material. Waterjet cutting also does not introduce any stresses into the material.

Obviously, you don't put your fingers in front of a waterjet cutting head while it is on. Anything that can cut through 10cm steel will make short work of flesh and bone. Aside from this, however, waterjets are very safe. A leak in a high-pressure water system tends to result in a rapid drop in pressure to safe levels. Water itself is safe and non-explosive and the garnet abrasive is also inert and non-toxic. One of the largest hazards is cuts from the sharp edges of material created by the waterjet.

As long as you are not machining hazardous material, the spent abrasive and waste material become suitable for land fill. The garnet abrasive is inert and can be disposed of with your other trash. Very little material is actually removed in the cutting process, so this keeps the environmental impact relatively low, even if you do machine the occasional hazardous material. The pumps do use a considerable amount of electricity, though, so there is some additional environmental and cost impact due to this.

The amount of material removed by the waterjet stream is typically about 0.5 mm wide, meaning that very little material is removed. When you are working with expensive material (such as titanium) or hazardous material (such as lead), this can be a significant benefit. It also means that you can get more parts from a given sheet of material.

Advantages of waterjets over lasers

Laser cutting involves using a laser focused on material to melt, burn, or vaporise the material. The laser can be a gas laser (such as CO2) or a solid-state laser. Waterjets have a number of advantages over lasers. In many respects, however, the two tools are complementary and many companies own both of them. Waterjet cutting does not heat your part. There is no HAZ or thermal distortion, which can occur with lasers. Waterjets do not change the properties of the material.

Waterjets can cut reflective materials that lasers cannot, such as copper and aluminum. Waterjets cut a wide range of material with no changes in setup required. Also, materials which are heat-sensitive can be cut using waterjets. Waterjets are more environmentally friendly, using garnet as the abrasive material. Garnet is a non-reactive mineral that is biologically inert. The only issue is when you are cutting a material that is potentially hazardous (such as lead), since small pieces of the material will be abraded and mix in with the spent garnet.

There are no noxious fumes, such as vaporised metal, and no risk of fires. The distance between the end of the waterjet nozzle and the material is typically very small, although caution is needed when the waterjet nozzle is raised.

With lasers, the material needs to be relatively uniform. In particular, when cutting over uneven surfaces, the laser can lose its focus and cutting power. A waterjet will retain much of its cutting power over uneven material. Although the material may deflect the cutting stream, it typically has a negligible effect.

For more information, visit our website.

Perfect Laser Technologies (Pty) Ltd
Unit 6, 451 Vale Ave, Randburg.
Tel: 010 157 0112
www.perfectlaser.co.za
sales1@perfectlaser.co.za