DVS MEDIA

Cutting Processes

oxyacetylene, plasma arc, laser beam, water jet cutting

Oxyacetylene cutting

In the case of oxyacetylene cutting, an oxygen / fuel gas flame serves as the heat source and acetylene, propane or natural gas is utilised as the fuel gas. A heating flame heats the material up to the inflammation temperature and cleans any rust, scale or other contaminations off the surface. The material burns into slag along the switched-on cutting oxygen jet. The combustion heat arising in this respect permits continuous combustion into the depth and in the advance direction. The very liquid slag is blown out of the kerf.

The prerequisite for oxyacetylene cutting is that the inflammation temperature of the material to be cut and the melting temperature of its slag are lower than the melting temperature of the material. The slag arising during the combustion must be very liquid and the material should exhibit a low thermal conductivity. This is the case, for example, with structural steels, low-alloyed steels, cast steel and titanium.

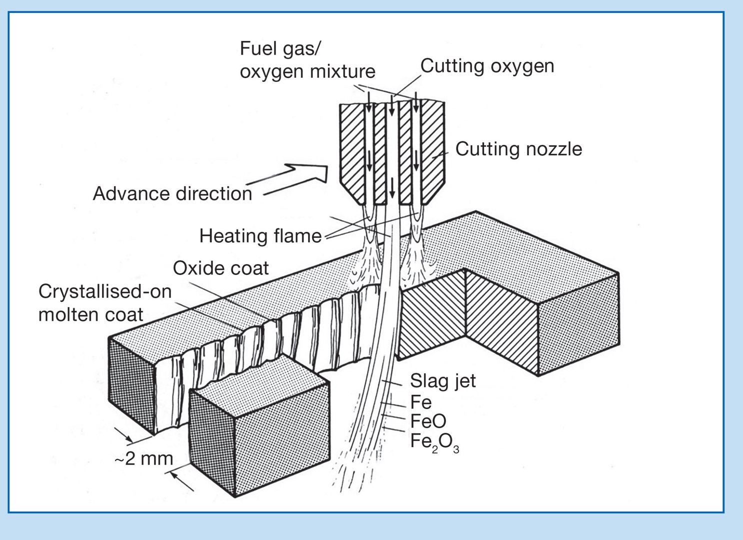
A tip: The correct gas cutting speed can be recognised by the flying sparks in the vertically downward direction.

Advantages

- low investment and operating costs
- can be utilised flexibly, e.g. on building sites
- widest area of application in relation to the workpiece thickness
- extremely suitable for the preparation of welds and for bevel cuts

Disadvantages

- material selection extremely restricted
- high thermal loads on the material



Plasma arc cutting

Plasma arc cutting can be used in order to carry out weld preparations and shaped cuts on materials which are not suitable for gas cutting. These are, for example, alloyed steel, aluminium, copper and grey cast iron. The plasma gas (nitrogen, nitrogen/hydrogen mixtures, argon/hydrogen mixtures and compressed air are applied) flows through the water-cooled cutting nozzle. The arc burning between the tungsten electrode and the workpiece heats the plasma gas up into a plasma jet at a temperature of approx. 30,000°C. The material melts completely along the plasma jet and is blown out of the groove. The following parameters have influences on the cutting results: the cutting current, the cutting speed, the distance between the plasma torch and the workpiece as well as the gas pressure and volume.

Because of the high noise burdens and air pollution, plasma arc cutting is frequently carried out industrially with water covering the workpiece. This also decreases the thermal impairment of the cut parts, particularly in the case of thin sheets.

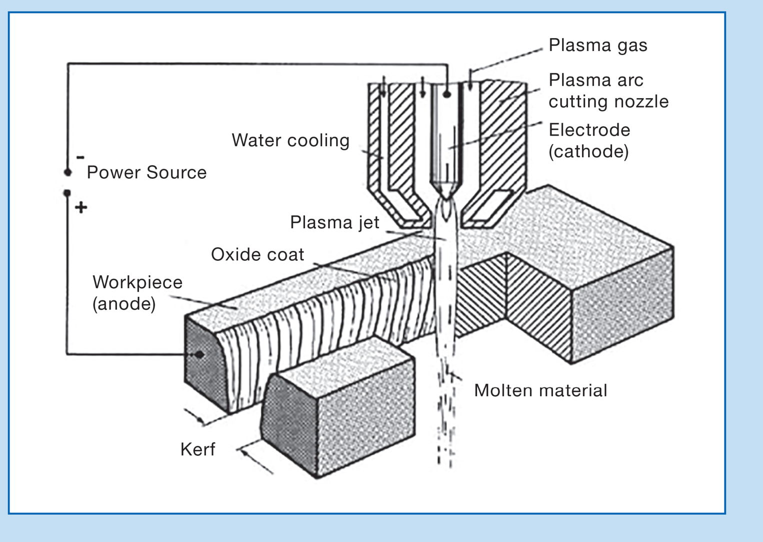
Advantages

- only thermal process for the cutting of high-alloyed steels and aluminium materials in the medium and higher thickness ranges
- outstanding for structural steel in the thin sheet range
- cutting of high-strength structural steels with a low heat input
- higher cutting speeds than in the case of oxyacetylene cutting

Disadvantages

- wider kerf than in the case of oxyacetylene cutting
- non-parallel cut edges
- very high noise burdens*
- high pollutant emissions*

* in the case of dry cutting



Laser beam cutting

Laser beam cutting is suitable for the cutting of the most diverse materials, e.g. steels, non-ferrous metals, plastics, ceramic or wood. In the case of ferrous materials, it is utilised mostly for workpiece thicknesses up to 25 mm. Not only CO_2 gas lasers but also solid-state lasers in the form of disc or fibre lasers are applied. Today, a high electrical/optical efficiency can be achieved with the diode-pumped solid-state laser.

A distinction is made between three process variants according to the type of transformation of the material in the kerf:

In the case of **laser beam gas cutting**, the material to be cut is heated up to the inflammation temperature by the focused laser beam. The cutting oxygen burns the material at the cutting point and forms a very liquid slag which is blown out of the kerf by the kinetic energy of the oxygen jet. The cutting operation corresponds to the combustion sequence in gas cutting. The most frequent application is therefore the cutting of mild and low-alloyed steels.

In the case of **laser beam fusion cutting**, the material is melted completely over the entire workpiece thickness by the laser beam. Here, a weakly reactive gas (as a rule, nitrogen) is utilised instead of the cutting oxygen and blows the molten material out of the kerf. Laser beam fusion cutting is predominantly utilised for the cutting of high-alloyed steels and for non-ferrous metals. The particular advantage of cutting high-alloyed steels with nitrogen relates to the metallically bright cut edges arising in this respect.

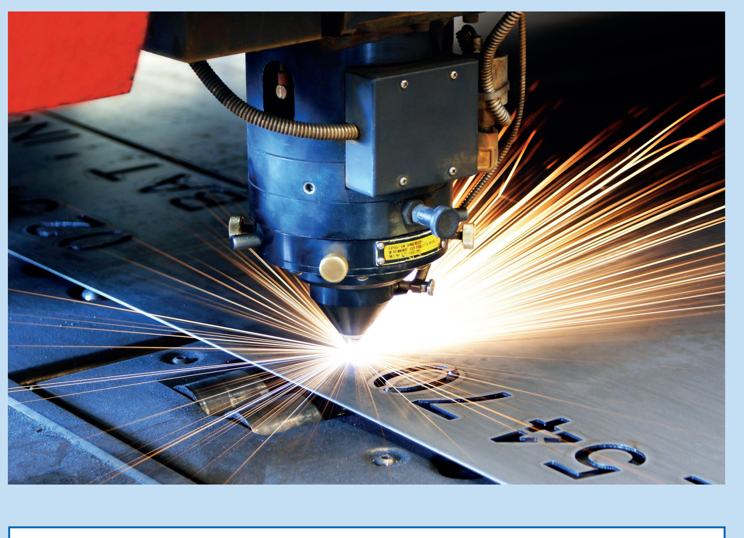
In the case of **laser beam sublimation cutting**, the material to be cut is vaporised (sublimated) by the high energy density of the laser beam. The vaporised material is blown out of the kerf by the vapour pressure and by a weakly reactive cutting gas. Laser beam sublimation cutting is used for the cutting of organic substances and for plastics.

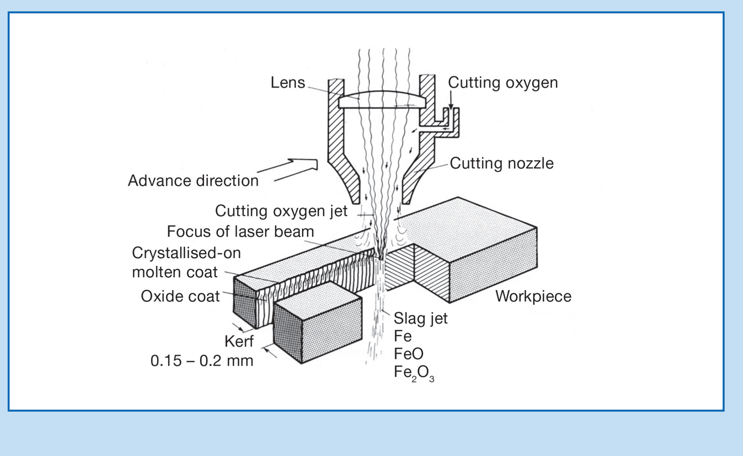
Advantages

- high cutting speed
- depending on the process, metallically bright cut edges without any remachining
- precisely cut contours with nearly parallel kerfs
- a wide diversity of materials, e.g. even non-ferrous metals, can be cut depending on the installation
- small heat-affected zones

Disadvantages

- in comparison with other thermal cutting processes, comparatively high investment costs
- limited plate thickness range (up to 50 mm with high-alloyed steel and up to approx. 25 mm with mild steel)





Water jet cutting

A number of non-thermal cutting processes are designated as water jet cutting. The fundamental feature of all the processes is a high-velocity jet which is generated in a nozzle as a result of decompression from a water pressure of up to 600 MPa to the ambient pressure. In the case of pure water jet cutting (PWJC), the erosive energy of the created jet can already be used for the cutting of softer materials. Customary cutting materials are technical precious stones such as sapphires, rubies and diamonds.

Hard materials can be cut by adding abrasive particles (e.g. garnet sand). In the case of water abrasive injector jet cutting (WAIJC), these particles are added in the low-pressure range. This yields numerous advantages with regard to the wear, the switchability and the interruption-free supply. The water jet moves across a mixing chamber in which it takes up the abrasive as well as air and accelerates. The mixture is focused by a hard metal tube and causes a micro chip removal process on the workpiece. This process is put to widespread industrial uses. Nearly all materials are cuttable, e.g. mild and high-alloyed steels, non-ferrous metals, plastics, foams, glass, rubber, natural stone and material composites (amongst others).

If abrasive particles are added in the high-pressure range, this is called water abrasive suspension jet cutting (WASJC). In the case of this process, the water flow is initially divided into a main flow and a secondary flow. After the secondary flow has rinsed an abrasive pressure vessel located in the high-pressure range, it is reunited with the main flow and they are both decompressed in a hard metal nozzle. The higher efficiency is counterbalanced by disadvantages such as the switchability or the non-interruption-free operation. Utilisation fields are offshore dismantling tasks, the decommissioning of nuclear technology installations or bomb defusing operations.

Advantages

- suitable for almost all materials, even for very high material thicknesses
- undercuts as well as hollow and sandwich structures possible
- small kerf width (0.2 1.2 mm)
- approximately right-angled cut faces
- high surface quality
- no thermal influences on the cut edges, no heat-affected zone and no oxide coat on the cut edges
- small environmental impacts

Disadvantages

- comparatively high investment costs
- lower cutting speeds