Beveling procedures and beveling machines

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Index

1. Fields of application





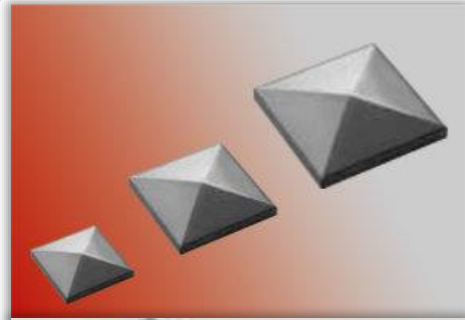






1.1 Why do we bevel?

- Optical Reasons / Facing
- Safety Reasons / Deburring
- Geometric Reasons / Dynamic Loads
- Weld Preparation



1.2 Welding and weld preparation

Altogether, there are more than 200 welding processes.

Some welding procedures only have historical significance. Some only differ in slight modifications, while others have not gone beyond the stages of special applications.

Since the use of malleable iron, joint welding has been used as forge weld. Since the Middle Ages, we have seen numerous examples of this process, such as weapons, armor, and chains.

In addition, the German word for welding is "Schweißen" which was derived from this technique. Parts were heated at the surface, and then welded together. The English word "welding" comes from the Middle English "wellen“ which meant to boil!

Lichtbogenschweißen

N.G.Slawjanow

1.3 The purpose of a weld seam

Welding: To produce a nondetachable connection of components with the application of heat or pressure and with or without filler materials.

The preparation of the compound of metals is according to the process in a weld seam, a welding point, or on the surface (friction-welding).

The welded section of the workpiece should have the same properties as the original material after the welding and cooling processes. Therefore, the weld preparation is particularly important.

1.4 Quality of a welding seam

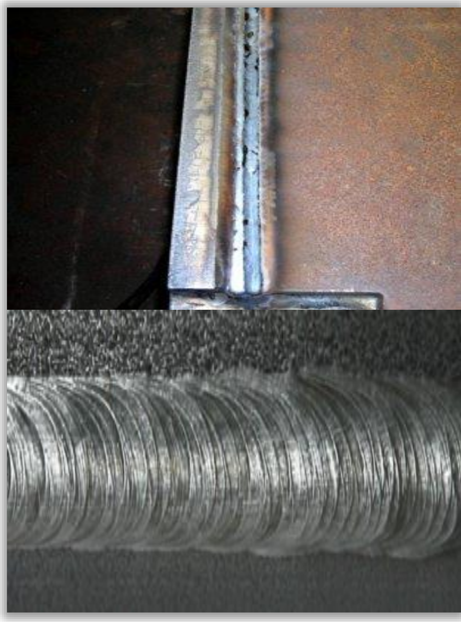
Each weld is only as good as the weld preparation.

A molten area exists at the junction where the two pieces are welded together. The material in the welded area will have cast-like properties after cooling.

The necessary material stability can only be achieved with complete penetration.

The primary quality characteristics of the weld are the weld depth and the width of the seam.

The aim is a homogeneous workpiece. The weld should preferably have the same material properties (strength and corrosion resistance) as the parent material.



2. Welding procedures

Autogeous Gas Welding

Correct designation: Autogenous Welding
A workpiece is heated with an open flame and connected directly or by means of welding wire.

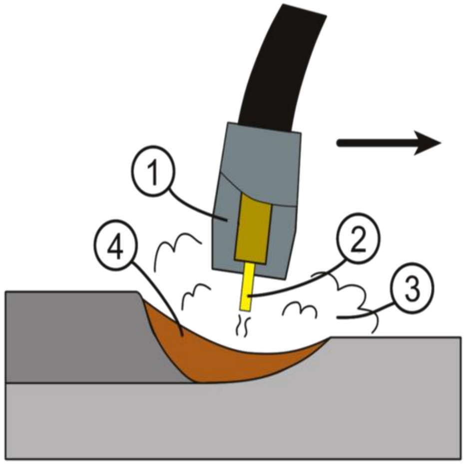
Arc Welding

This is the oldest welding procedure (1885).
Within this process an electronic arc is used as a heat source.
The coated electrode is melting which forms and protects the weld.

Gas-Shielded Welding (MIG / MAG / TIG)

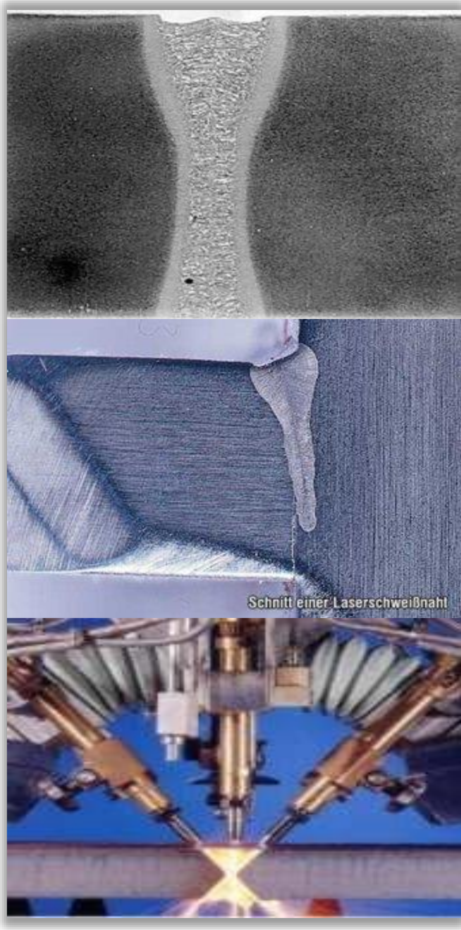
SIGMA-welding (*"shielded inert gas metal arc"*).

MAG: Metal Active Gas Welding
MIG: Metal Inert Gas Welding
TIG: Tungsten Inert Gas Welding



3. Weld forms

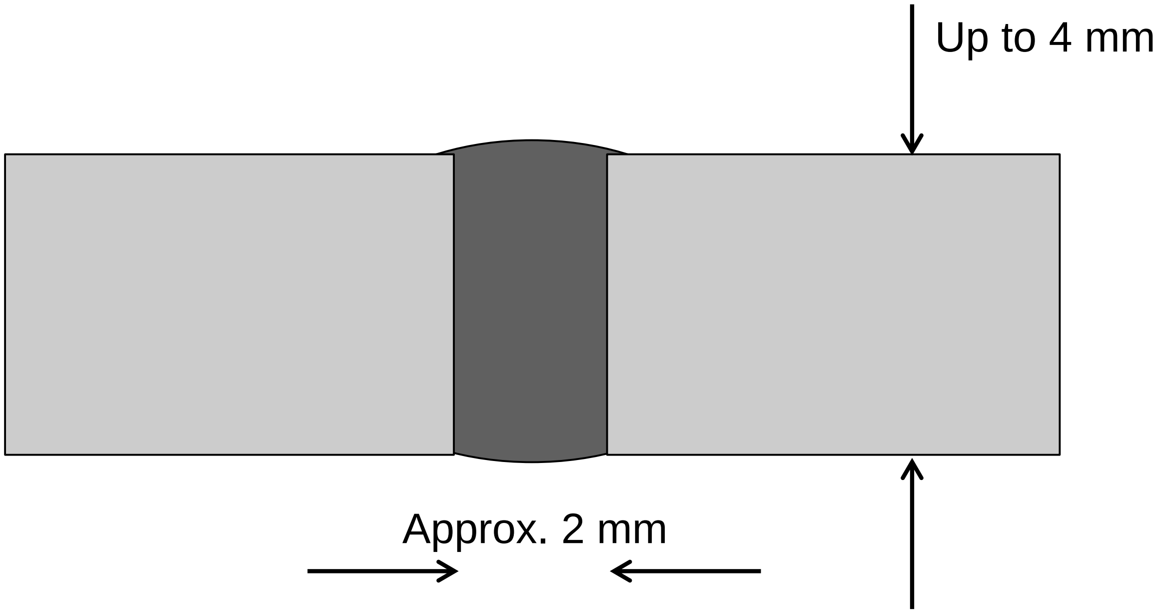
Bennenung	Vorsatzbuchstaben: H=Halb D=Doppel	Symbol	Grund-symbol	Fügeform	Nahtform
Bördelnaht			Ja		
I-Naht			Ja		
V-Naht			Ja		
HV-Naht	H		Ja		
Y-Naht			Ja		
HY-Naht	H		Ja		
U-Naht			Ja		
HU-Naht (Jot-Naht)	H		Ja		
Steilflankennaht			Ja		
Halb- Steilflankennaht			Ja		
Stirnflachnaht			Ja		
DV-Naht (X-Naht)	D				
DHV-Naht (K-Naht)	D H				
DY-Naht	D				
DHY-Naht (K-Stegnaht)	D H				
DU-Naht	D				
DHU-Naht (Doppel-Jot-Naht)	D H				
VU-Naht					
V-Naht mit Gegennaht					

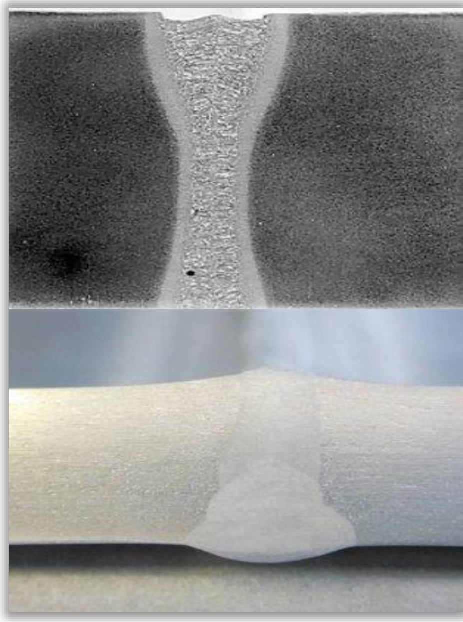


3.1 Weld forms

Edge form and seam type depend partly or completely on the Welding process.

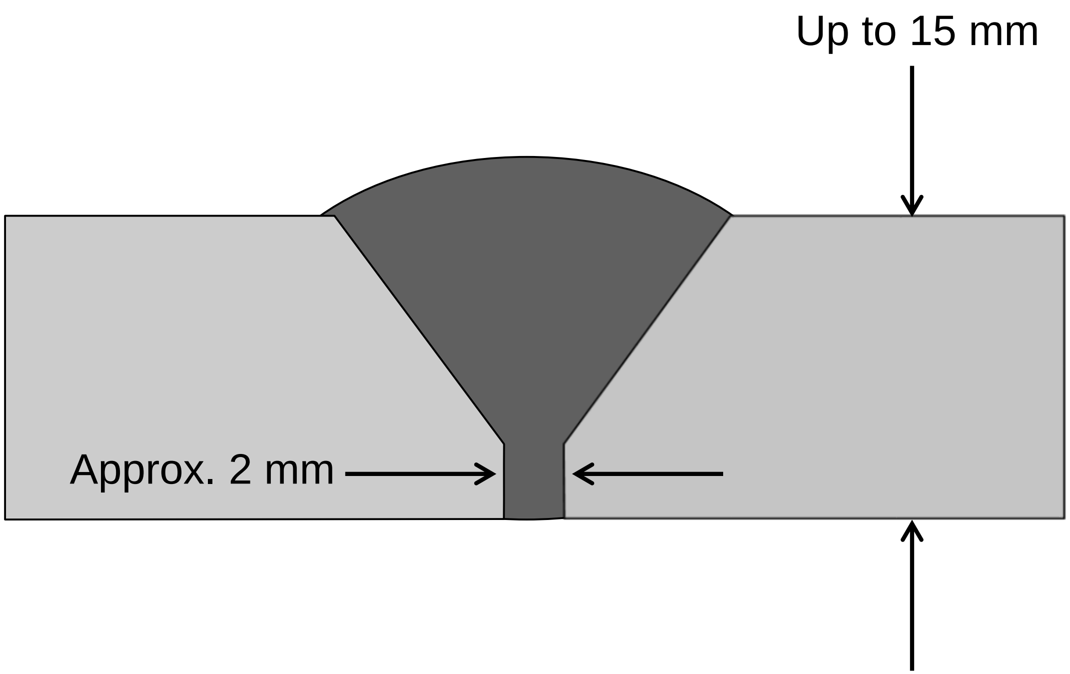
The I-Seam





3.2 Weld forms

The Single-V Butt Weld



3.3 Weld forms

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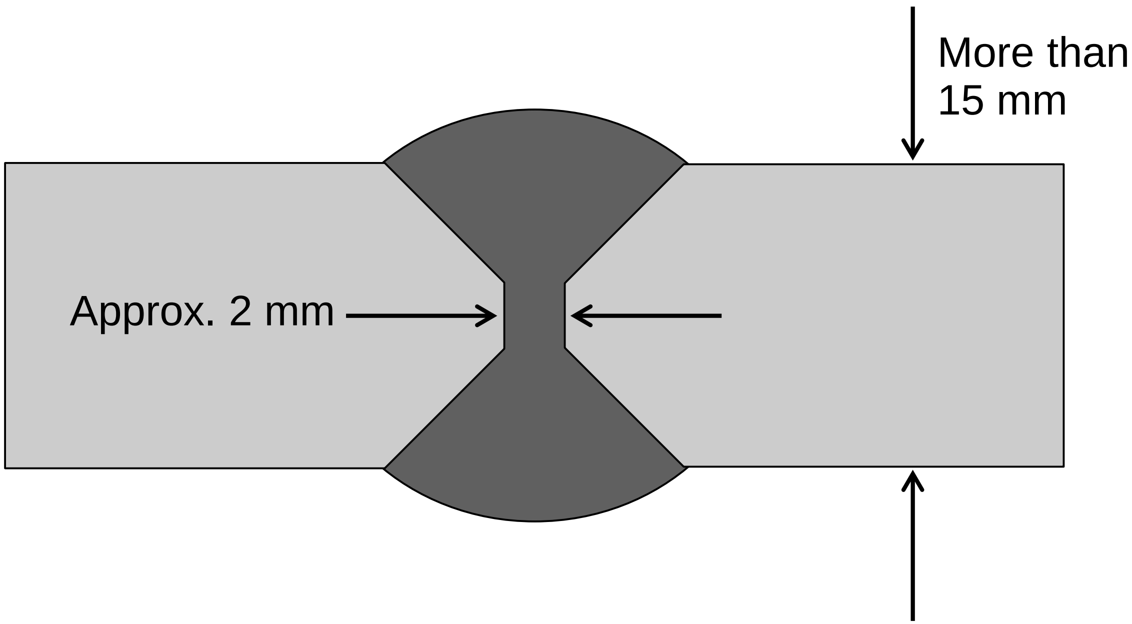
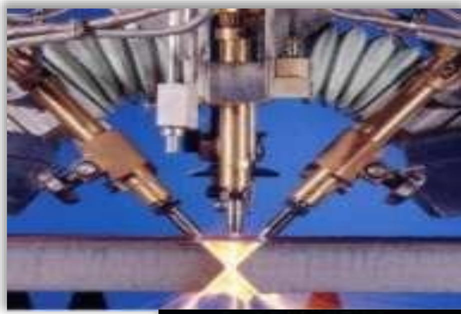
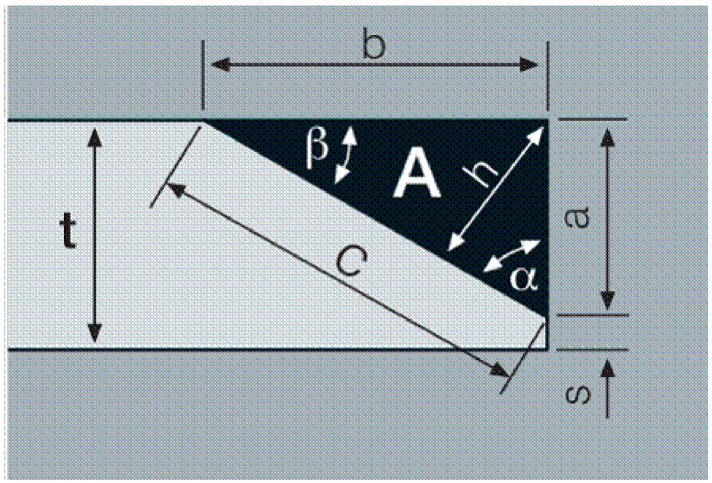
The Double-V Butt Weld





4. Geometry of a bevel



a = leg length a (mm)	a = t – s = b / tan α
b = leg length b (mm)	b = a * tan α
C = bevel width (mm)	C = a / cos α
t = plate thickness (mm)	
h = pevel height (mm)	h = a * sin α
s = land width (mm)	s = t - a
α = bevel angle (°)	α = 90° - β
β = opposite angle (°)	β = 90° - α
A = bevel size (mm^2)	A = a^2 * tan α /2 = a * b /
2	

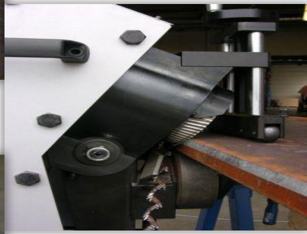
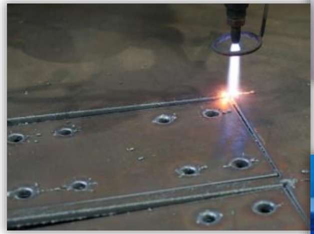
5. User groups

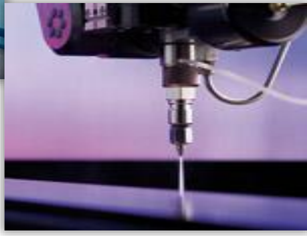
- Steel Construction: Work and protection scaffolding, buildings, stairs and railings, shipbuilding, crane construction, plant construction, plant manufacturing, offshore rigs, wind power stations, mechanical engineering designs.
- Mechanical Engineering: Parts and components of all kinds.
- Tank & Vessel Construction: Vessels and equipment for the chemical and petrochemical sector, pressure containers, heat exchangers and boilers.
- Pipeline Construction: Pipeline construction for power stations, chemisty and chemistry of rocks, distict heating, heating, gas, water and effluent.

6. Beveling procedures

- Milling
- Grinding
- Shearing
- Autogenous Gas Cutting
- Plasma Arc Cutting
- Laser Beam Cutting
- Water Jet Cutting / Abrasive Water Jet Cutting



6.1 Milling

Our products include both stationary and portable milling machines. Milling machines are useful when accurate and / or quality bevels are required.

The advantages are:

- Clean, burr-free surface
- No abrasive dust or heat input
- Very accurate

Important: Milling is only possible in counter rotation.

That means:

- On outside edges always move left to right!
- On inner edges and holes always move clockwise!

6.2 Grinding

Our products include both stationary and portable grinding machines. Grinding machines are useful for very hard materials and large bevels.

The advantages are as follows:

- Suitable for all types of steel
- All angles and a large bevel width are possible
- Very high quality bevel

6.3 Shearing

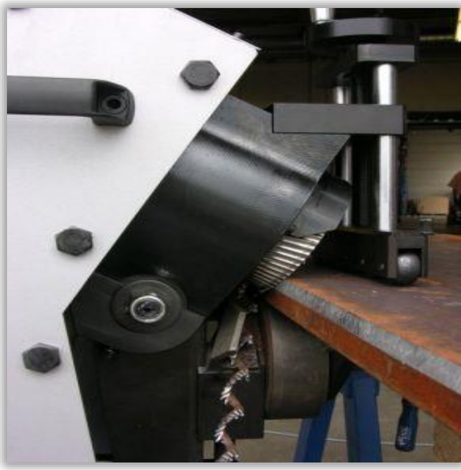
The shearing machines can be used portable or stationary, depending on the application.

Shearing machines are often used in container and tank / vessel construction.

The advantages are as follows:

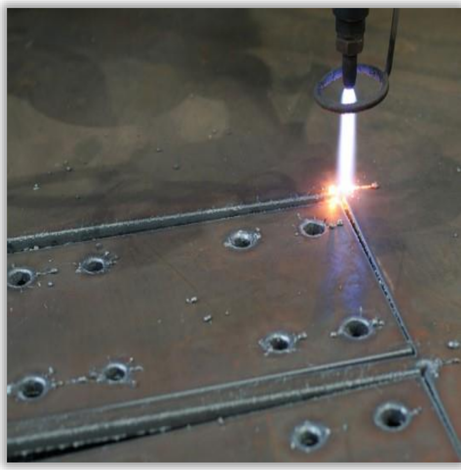
- No heat input
- Long tool life
- Shearing machines automatically move along the plate

This form of machining works particularly well on stainless steel, but is limited to a 25 mm bevel width.



6.4 Autogenous Gas Cutting

In autogenous cutting, the material is heated by the flame to reach the ignition temperature and is then burned by the oxygen beam.



The oxygen reacts only with the heated material when the ignition temperature of the material is below the melting temperature.

The ignition temperature is primarily dependent on the alloy components of the material.

Only normal construction steels with a carbon content of up to 0.3% are suitable for thermal cutting.

6.5 Plasma Arc Cutting

With a plasma cutter, an arc burns between a tungsten electrode and the workpiece. The workpiece is extremely hot and melts at the point of impact.

The weld pool will be blown away by a jet of gas (air or inert gas), whereby the cut will be made. Systems with 300 amps can typically penetrate up to 70 mm steel.

A characteristic of a plasma cutting gap is the rounding of the edge at the point of entry.

The advantage compared to autogenous flame cutting is primarily in the cutting speed, which is about 4 times faster.

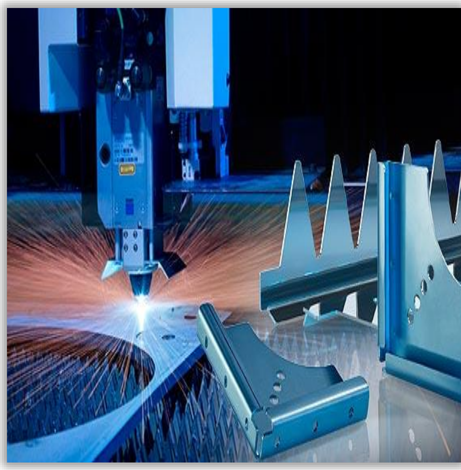
Typical Thicknesses:

Construction Steel:	ca.40 mm
Alloy Steel:	ca.40 mm
Aluminum:	ca.40 mm

6.6 Laser Beam Cutting

Laser cutting, like plasma cutting, consists of two subtasks:

1. The laser beam heats the workpiece.
2. A jet of gas pushes the material out of the cut and protects the optical lenses from vapors and splashes.



Distinctions are:

Laser Fusion Cutting

Liquefied material will be blown away with inert gas.

Laser Oxygen Cutting

Heated material is burned with oxygen.

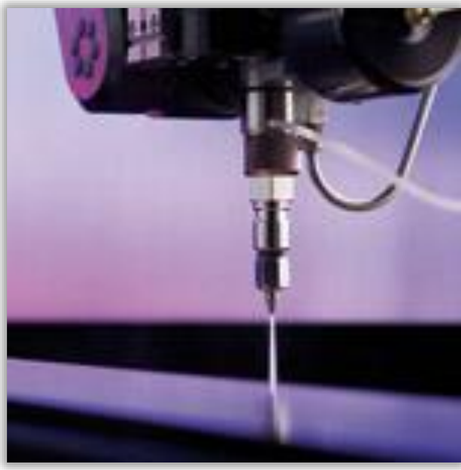
Laser Sublimation Cutting

Vaporized material is blown away with inert gas.

Typical Thicknesses:

Construction Steel:	ca.20 mm
Alloy Steel:	ca.15 mm
Aluminum:	ca.10 mm

6.7 Water Jet Cutting / Abrasive Water Jet Cutting



Waterjet Cutting: The material is separated by a high pressure water jet. This water jet has a pressure of up to 6000 bar or 87 kpsi.

Water jet speeds achieve up to 1000 m/s. This is equivalent to 3600 km/h or 2200 m.p.h., triple the speed of sound.

Heat input is very low.

To increase the cutting power, an abrasive material such as corundum is added to the water.

7. Summary beveling procedures

Procedures	Advantages	Disadvantages
Milling	Clean burrs and oxide-free cutting surface; no grinding dust or heat input; very accurate.	Faster insert wear for alloy steels; limited land width possible.
Grinding	Suitable for all types of steel; all bevel angles and all bevel widths with high quality.	Development of grinding dust; application-dependent long processing time.
Shearing	No heat input; long lifetime of the tools.	Limited usage, typically up to 20 mm bevel width. .
Autogenous	Low capital and consumable costs; bevel up to three cutters possible on one head; for medium and larger material thicknesses.	Suitable only for structural steels; bad cuts below 5 mm → material delay, setting work necessary; high heat input; large affected zone; low dimensional accuracy.
Plasma	Cutting of alloyed steels and aluminum materials in thin and medium range; higher cutting speed than with autogenous cutting.	Thermal distortion of the workpiece; limited use, typically up to 30 mm; Wider cut than lasers.
Laser	High component precision in thin and medium range; small cut width (0.2 - 0.4 mm).	Highest capital and operating costs; limited thicknesses possible; Construction steel / alloy steel / aluminum: 20/15/10 mm.
Water Jet	No metallurgical changes at the cutting area: no heat input, high accuracy possible (0.1 mm to 1 m length).	High capital and operating costs.

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