Laser-based joining

Perfect quality without residues

TRUMPF offers a comprehensive package for plastic welding with lasers

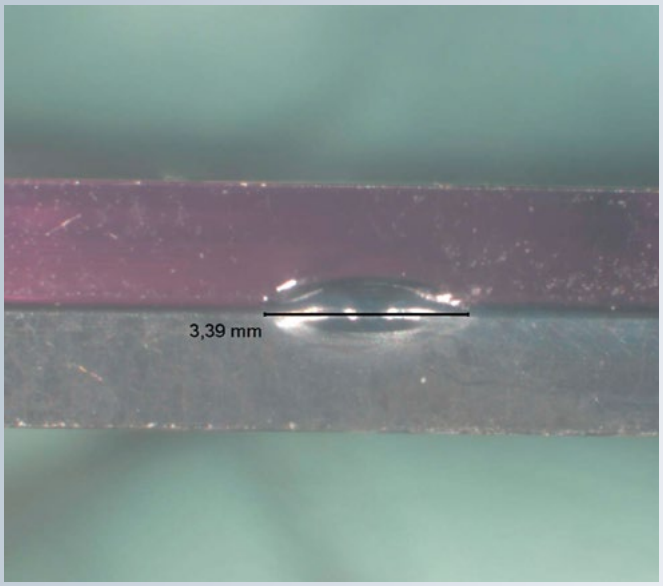
The laser-based joining of plastic delivers high-quality and reproducible results. The weld seam can be modified to any new component geometries. The heat input is spatially limited and is gentle with sensitive electronics. Compared to gluing or vibration and ultrasonic welding, there are no adhesive residues or plastic flakes. The process is both quiet and causes little wear.

TRUMPF

Machine tools/Power tools
Laser technology/Electronics

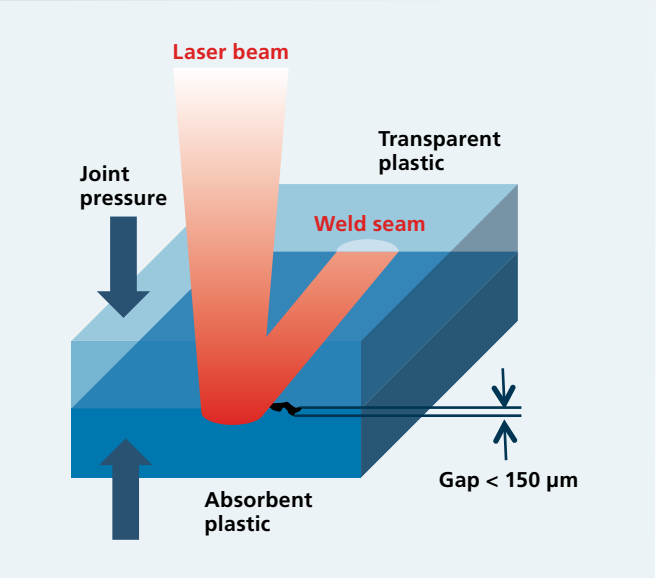
The process

With the laser transmission welding of an overlapping joint, both a plastic transparent for the laser wavelength and an absorbent plastic are used. The transparent mating part lets the laser light through, while the absorbent part heats up. The absorbent plastic melts the transparent plastic at the joint zone.

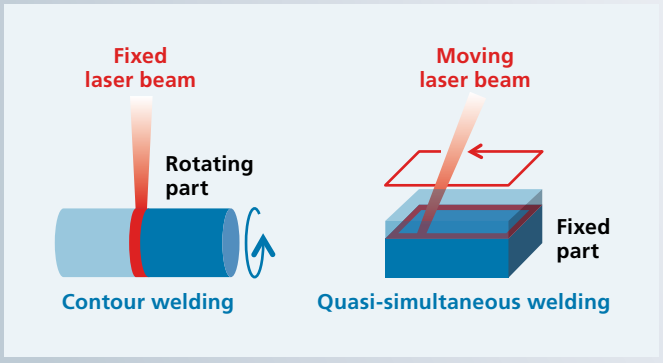


Joint pressure

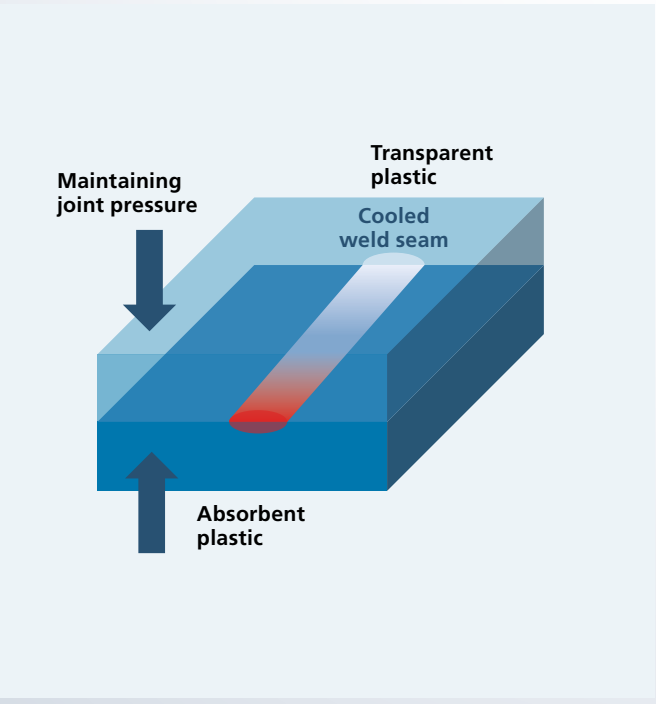
Air is a bad conductor of heat. The mating parts have to be pressed together to achieve a sufficient heat transfer. That is why a suitable fixture is necessary. A gap of less than 150 µm is to be obtained.



Round parts are often contour-welded with fixed optics and the mating parts are rotating at up to 25 m/min under the laser beam. Housings are welded quasi-simultaneously at speeds up to 15 m/s with scanner optics. The high speeds require a scanner with good contour precision.

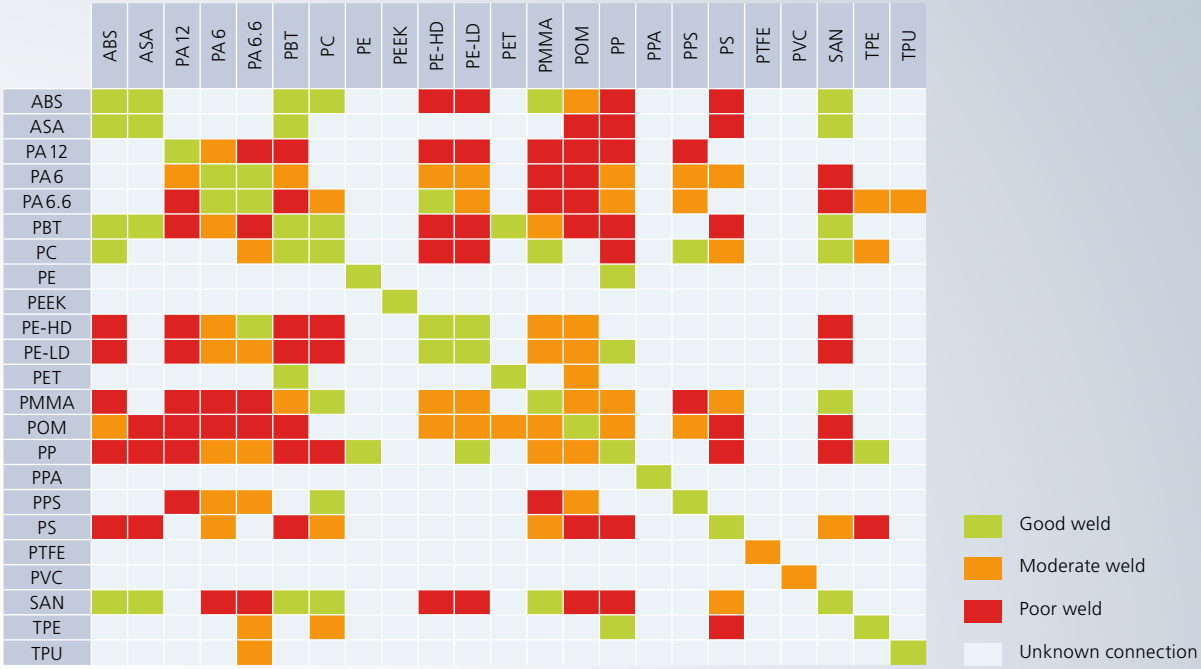


To achieve a permanent bond, the melted plastic has to set completely. This is why the fixture needs to press the two mating parts together for a certain holding time after the actual welding process.



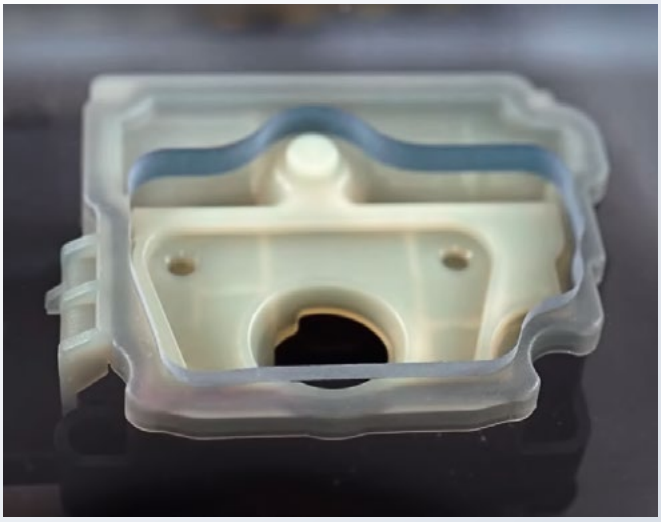
Raw material

The joining of the same kind of plastics represents the highest joint stability. The weldability of different materials is shown in the material pairing matrix. A high proportion of glass fiber leads to brittle welding bonds. It is recommended that the glass fiber content should not exceed 40 %. The typical maximum thickness of the laser-transparent material with glass fiber should not exceed 2 mm.



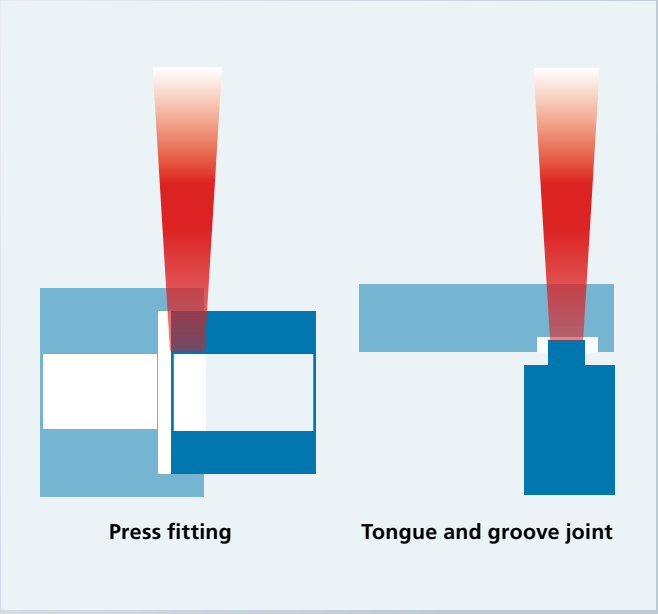
The fixture

A suitable holder should position the components in a reproducible way. The joining force is generated by pressing the parts against a mask that is accurate to the part's contour or against a special glass. This special glass must transmit the laser light at high mechanical stability.



The part

With rotationally symmetrical parts, a flat-on-flat bond with a press fitting is suitable. With axially welded components, easy positioning is possible using tongue and groove joints. The typical width of the weld web is about 1 mm and the height needs to be adapted to the part.



TRUMPF offers you these plastic welding solutions

Lasers			
Available laser		TruDiode 151	TruDiode 301
Wavelength	nm	938, 968	938, 968, 1000, 1031
Laser power	W	150	300
Beam quality	mm	< 8 mm · mrad	
19" version without cooler, dimensions (W x D x H)	mm	483 x 513 x 495	
Stand-alone version with cooler, dimensions (W x D x H)	mm	600 x 800 x 1500	

Fixture technology		
Available fixture equipment		Customer-specific modifications for applications, pull-out drawers and precision stop pins for high repeatability
Strength levels		Modular, adaptable strength levels using multiple cylinders, with 3 cylinders as the standard
Maximum strength	N	1200
Maximum pressure	bar	5

Optics and process sensor systems				
Available optics		PFO 20-2	BEO D50	BEO D35
Available sensor systems		Temperature control, melt travel monitor	Temperature control	–
Pyrometer measurement range	°C	180 to 520 (with emission factor ε = 1)		
Pyrometer measurement rate	kHz	2.0 (500 µs)		
Cycle frequency of the temperature controller	kHz	12.5 (80 µs)		
Typical precision of the temperature controller	%	3 at 250 °C, providing there is an annual calibration		
Resolution of the melt travel monitor	bit	12		
Typical accuracy of the melt travel monitor	%	< 0.5		

Subject to alteration. Only specifications in our offer and order confirmation are binding.

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