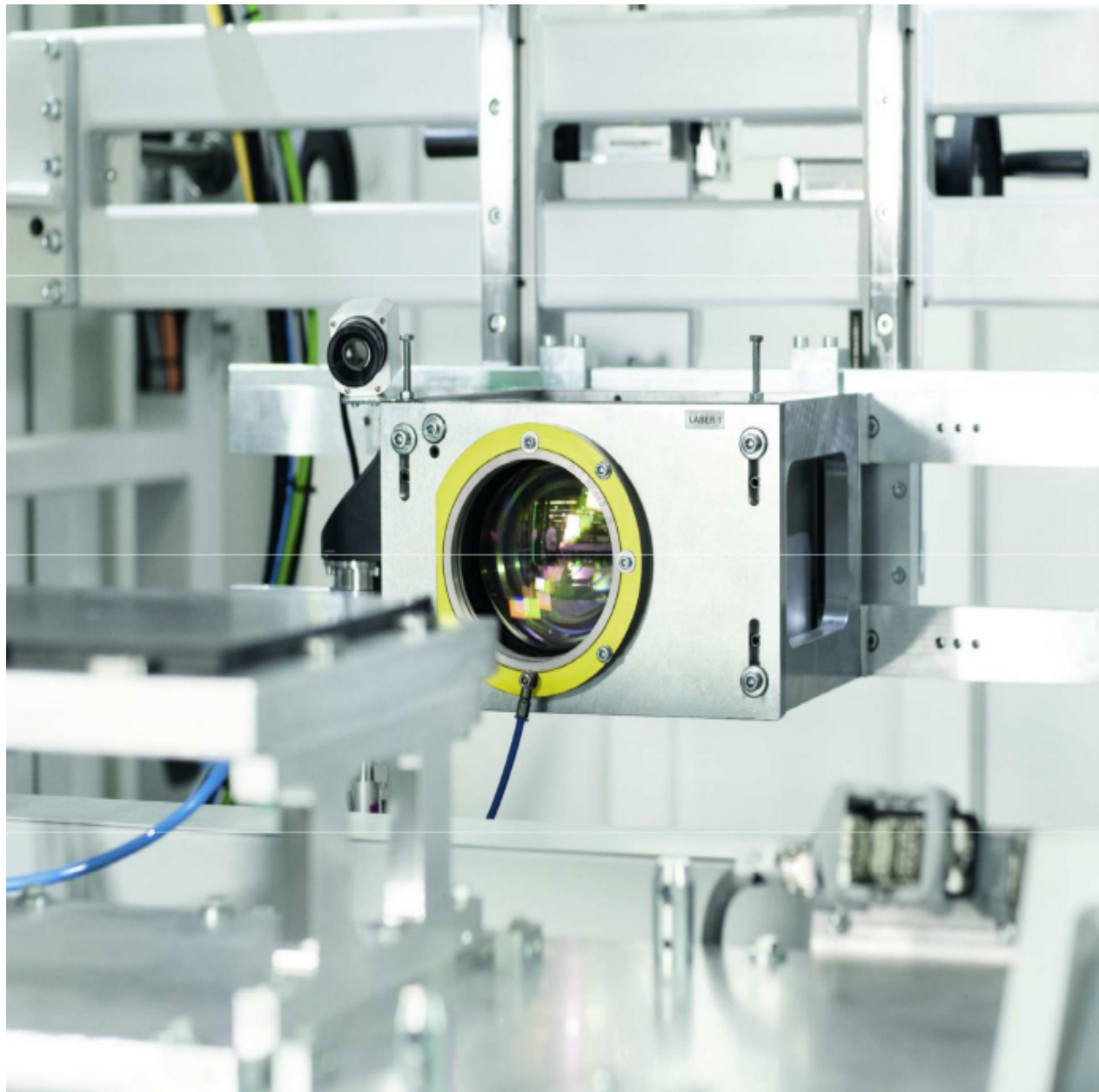


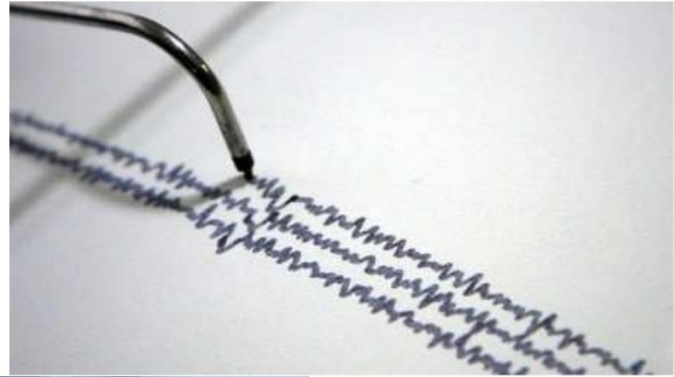


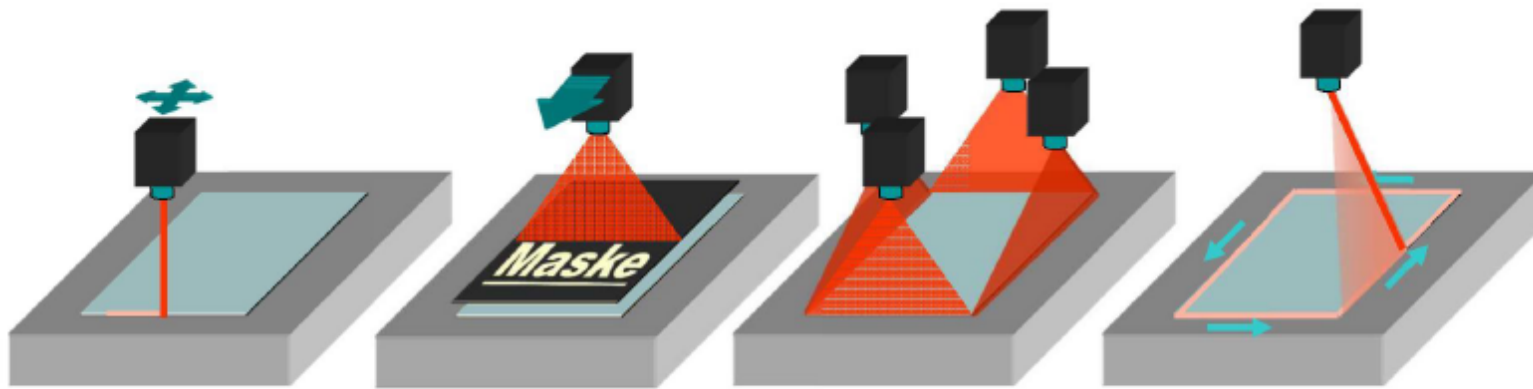
Laser welding
of plastics

Laser welding of plastics

Laser welding offers the possibility of welding sensitive components with the highest cleanliness requirements. Process advantages are:

- No vibrations and shocks
- Small heat-affected zone (HAZ)
- No component contamination from the process
- Suitable for clean rooms
- Leak tight and pressure resistant weld joints



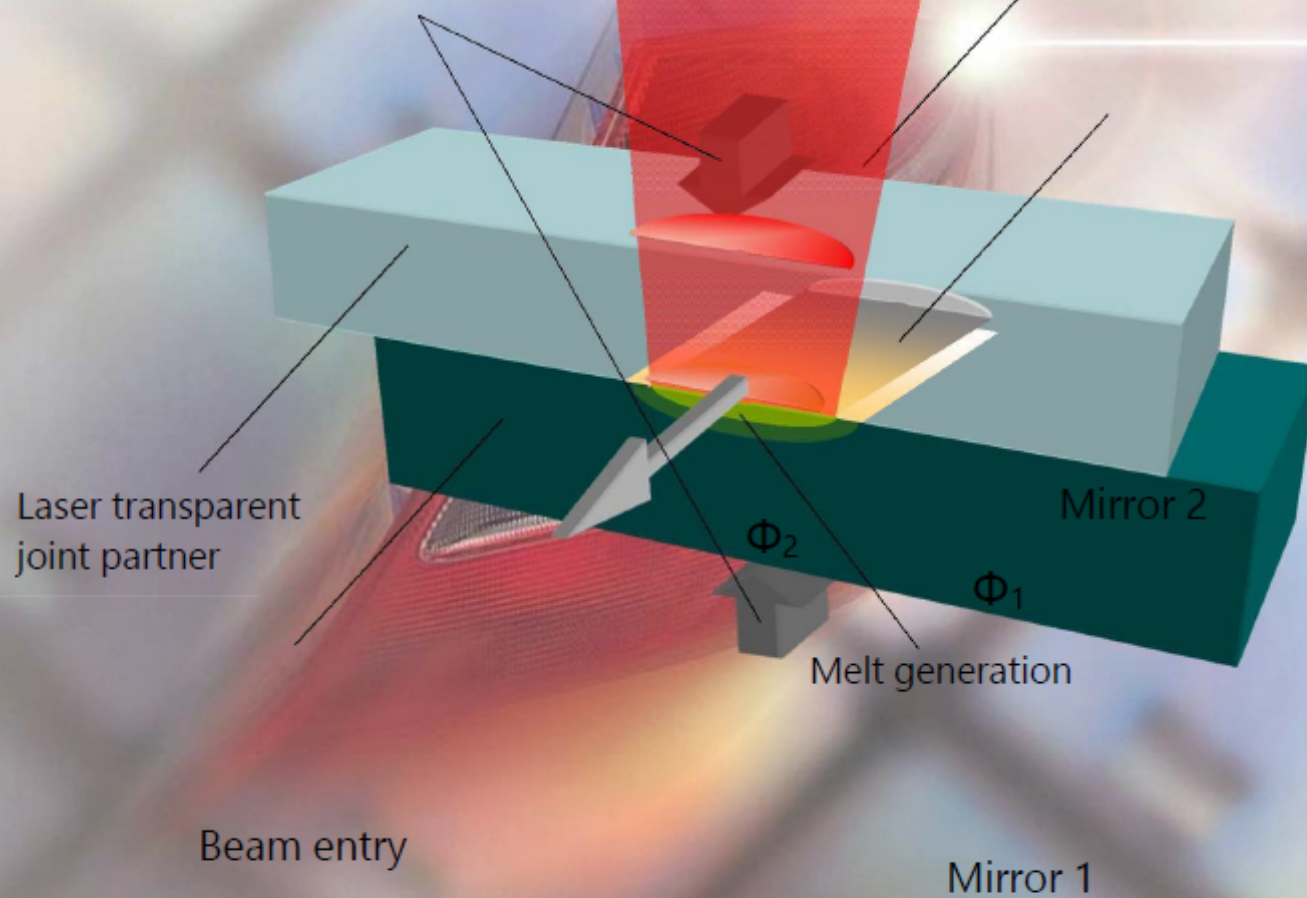


Laser welding variants

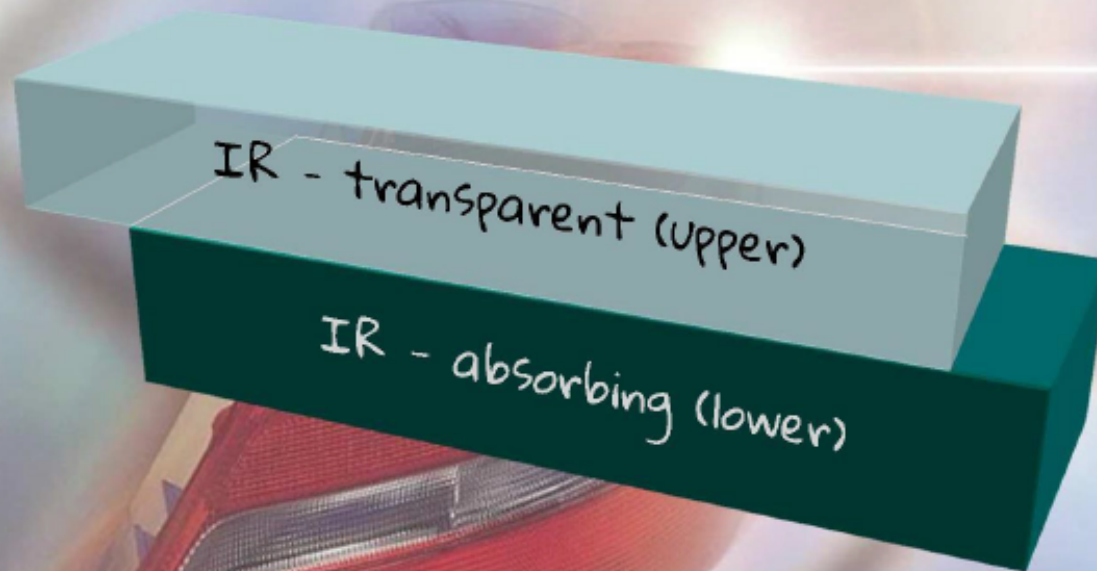
Contour	Mask	Simultaneous	Quasisimultaneous
2D and 3D contours	2D Contours	2D and 3D Contours	2D and limited 3D Contours
Very flexible technique	Very fine welds possible	Short welding times	very flexible process with short welding times
Ideal for large parts and many variants	Ideal for micro and small parts	Ideal for very high production numbers and complex weld seam	Ideal for high numbers and many variants
Limited process control, no displacement (penetration)	Limited process control, no displacement, small parts	High cost, Not flexible	Limited part geometry
HPDL / Nd:YAG / Fiber	HPDL	HPDL	HPDL / Nd:YAG / Fibe

Quasi simultaneous welding

Beam deflection in X- and Y-direction by galvanometer-scanner



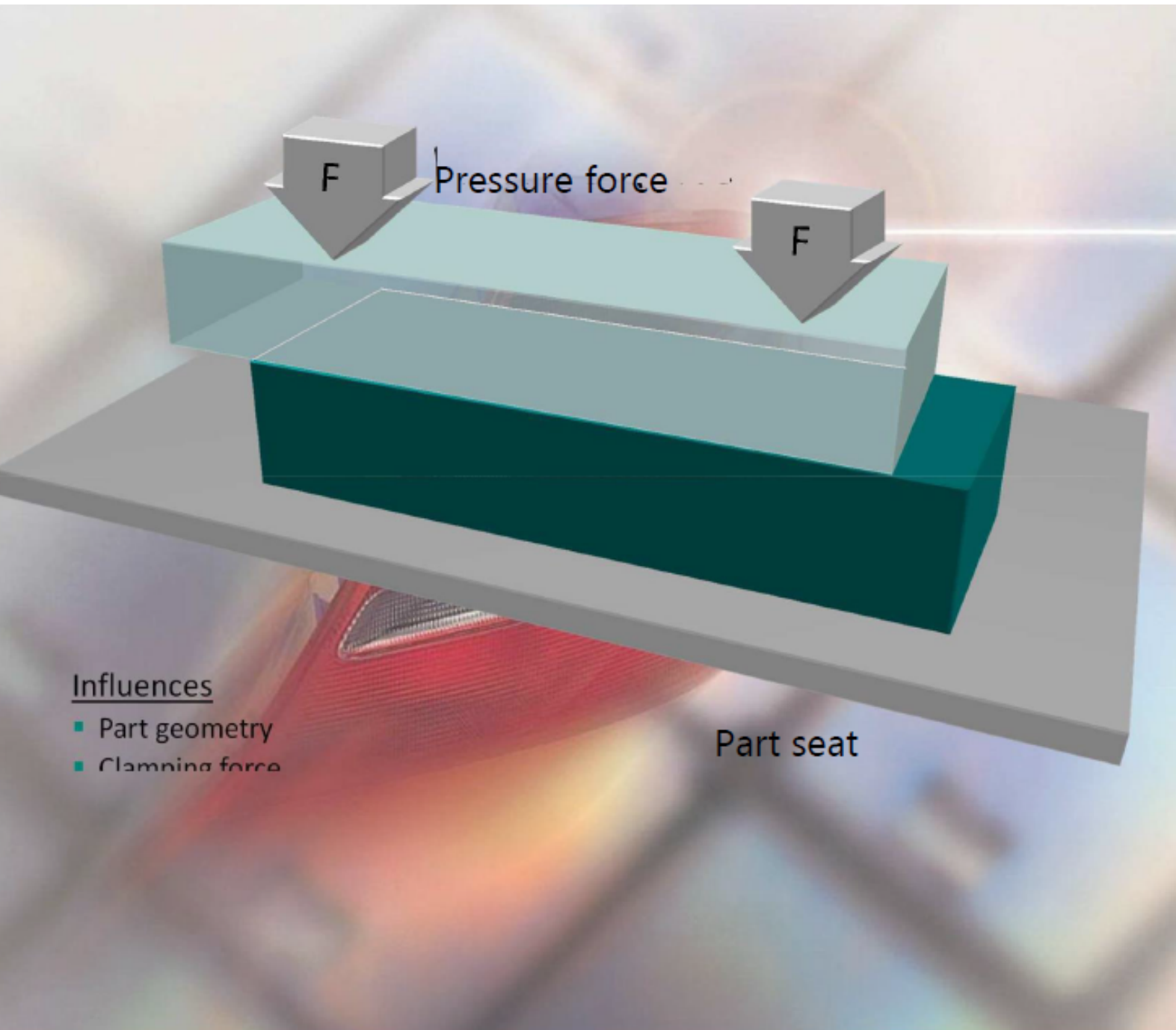
Transmission welding



Material combination

Influences

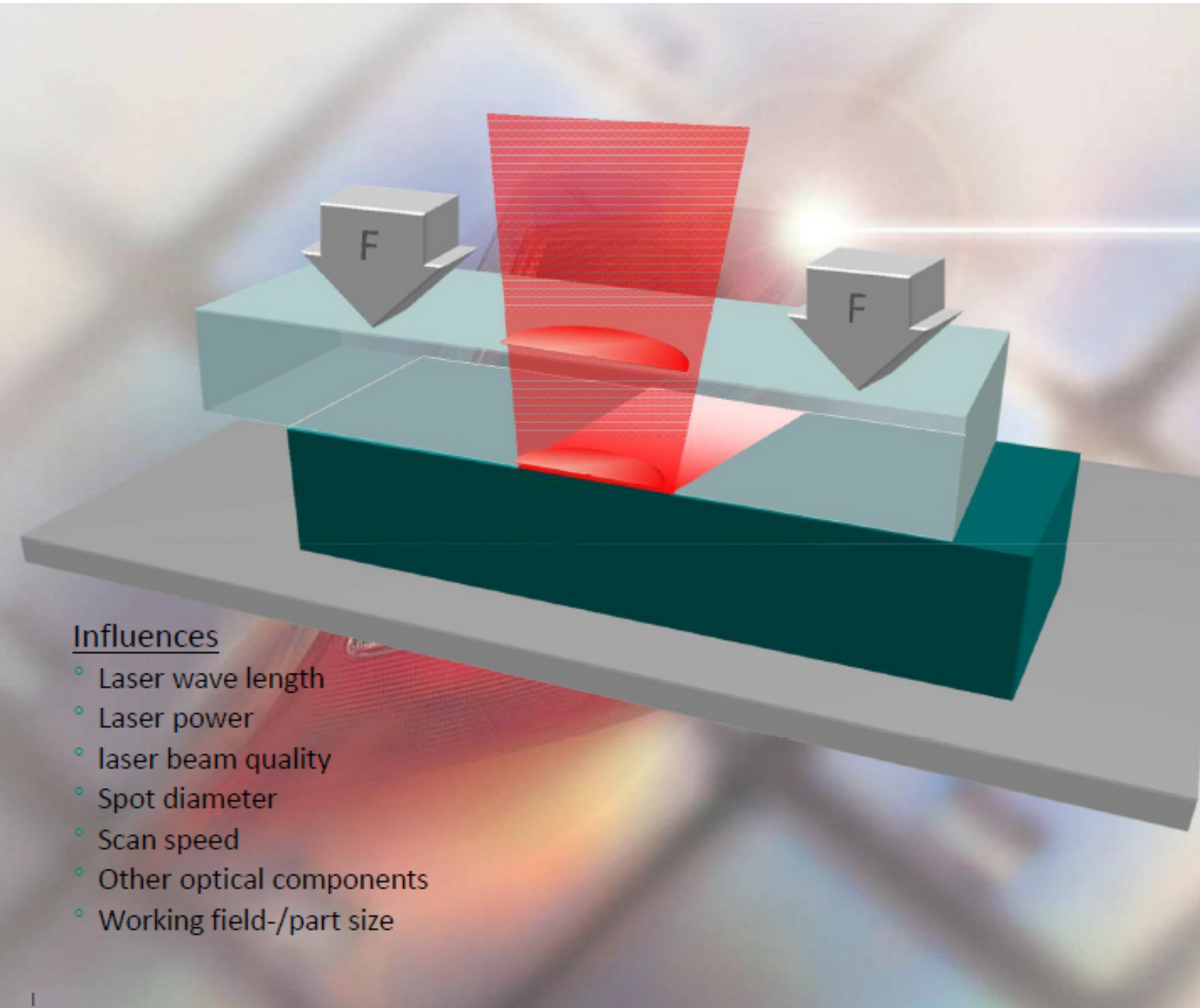
- Type of polymer/ -combination
- Additives, fillers, reinforcement
- Homogeneity of mixture
- Thickness of upper part
- Optical properties
- Scratches / cleanliness / humidity



Influences

- Part geometry
- Clamping force

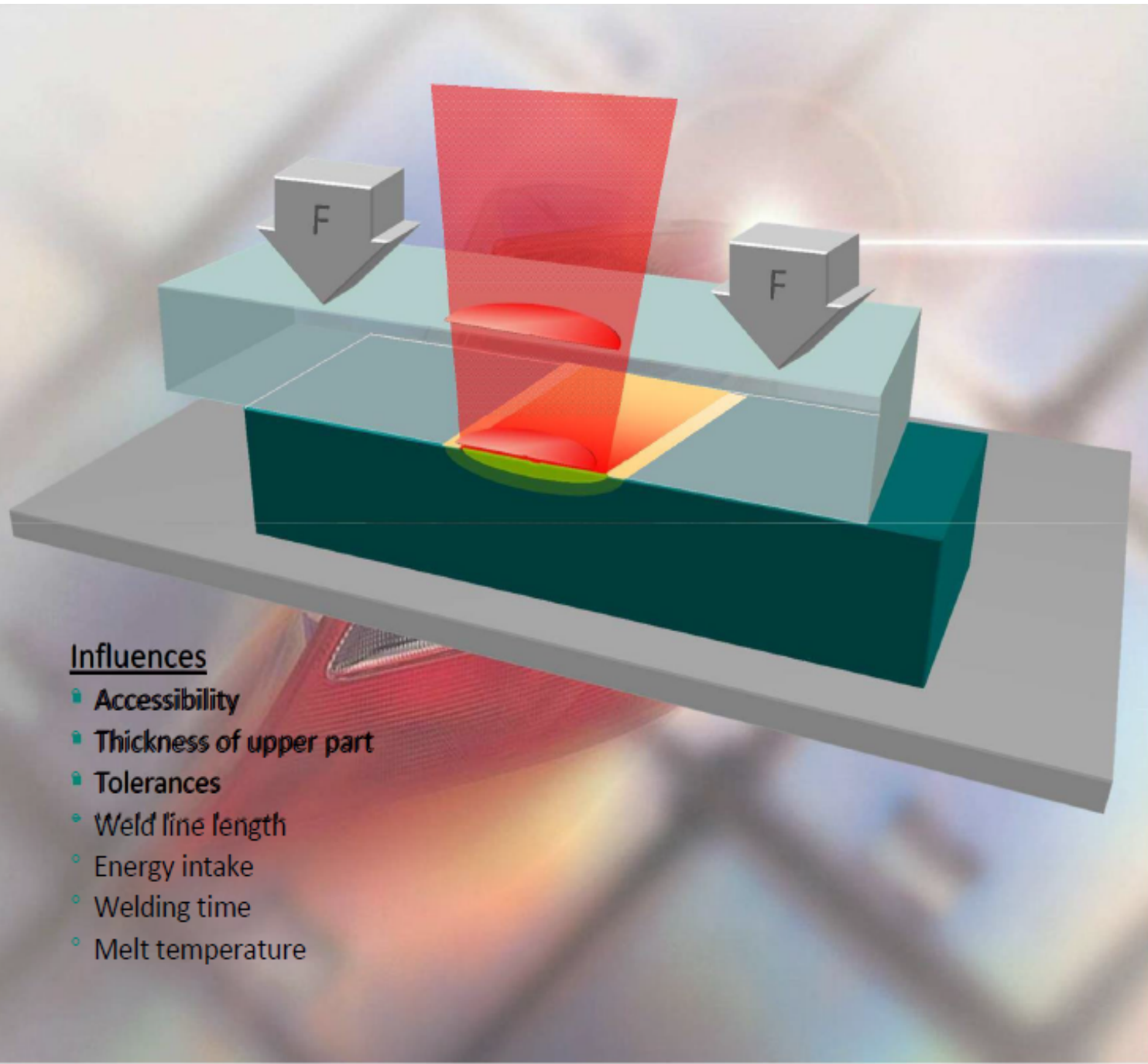
Clamping system



Beam source

Influences

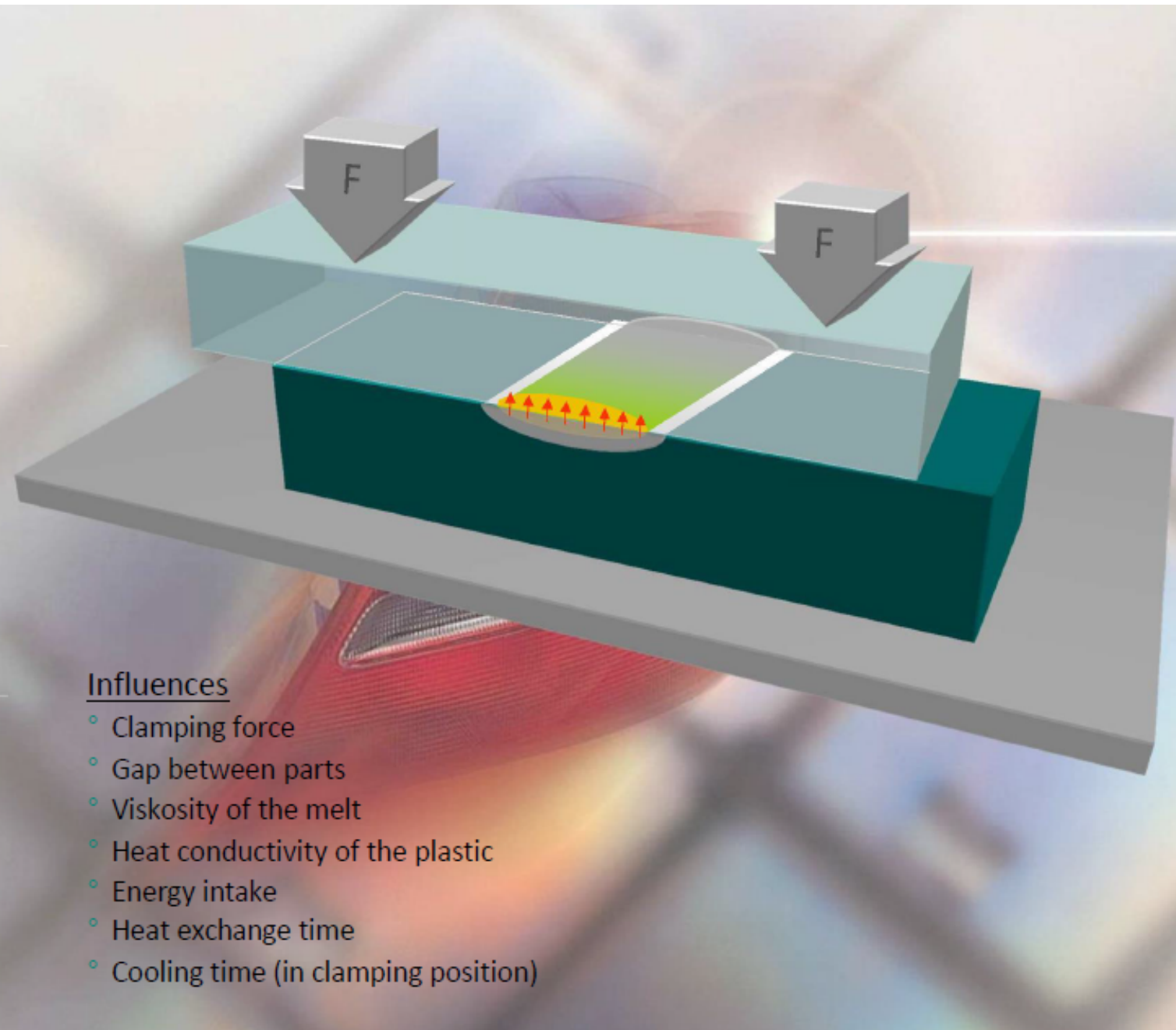
- Laser wave length
- Laser power
- laser beam quality
- Spot diameter
- Scan speed
- Other optical components
- Working field-/part size



Melt generation

Influences

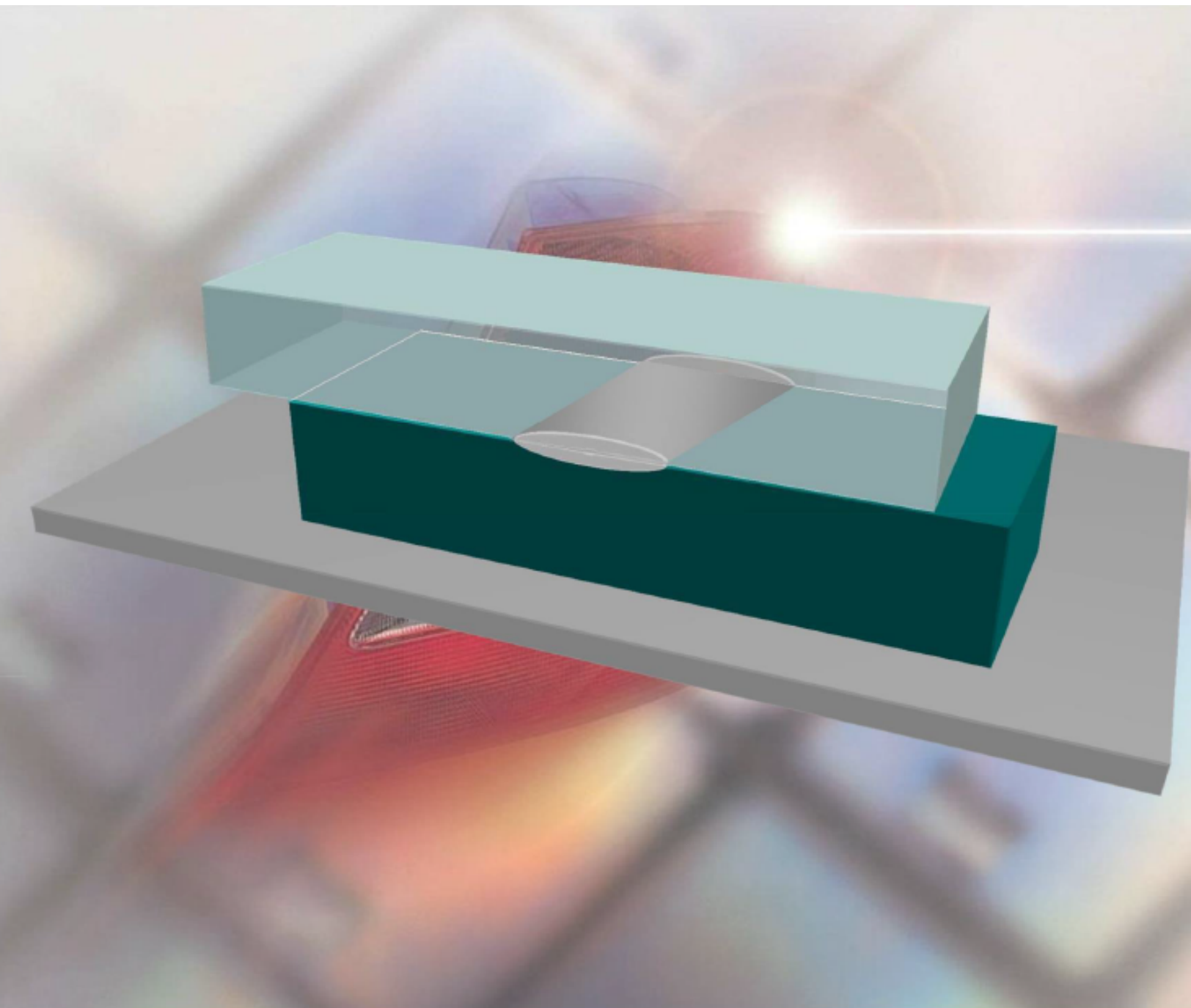
- Accessibility
- Thickness of upper part
- Tolerances
- Weld line length
- Energy intake
- Welding time
- Melt temperature



**Heat conduction into
upper part**

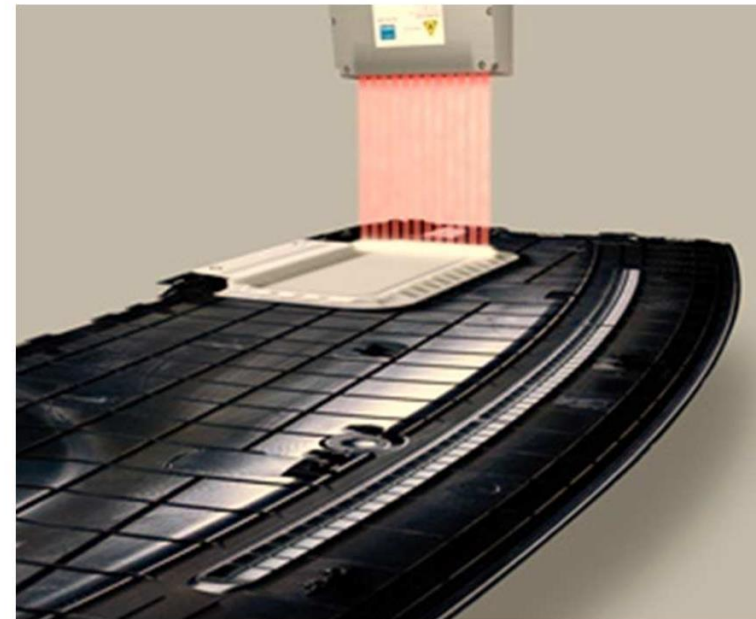
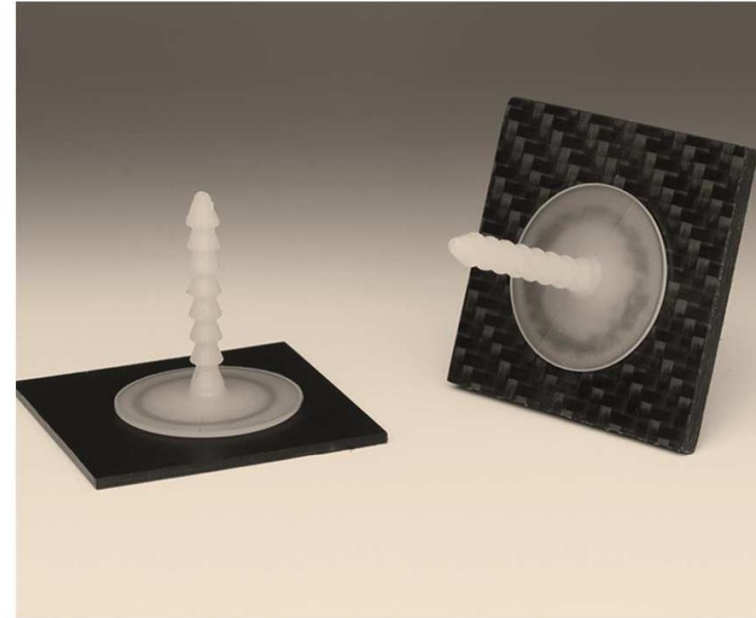
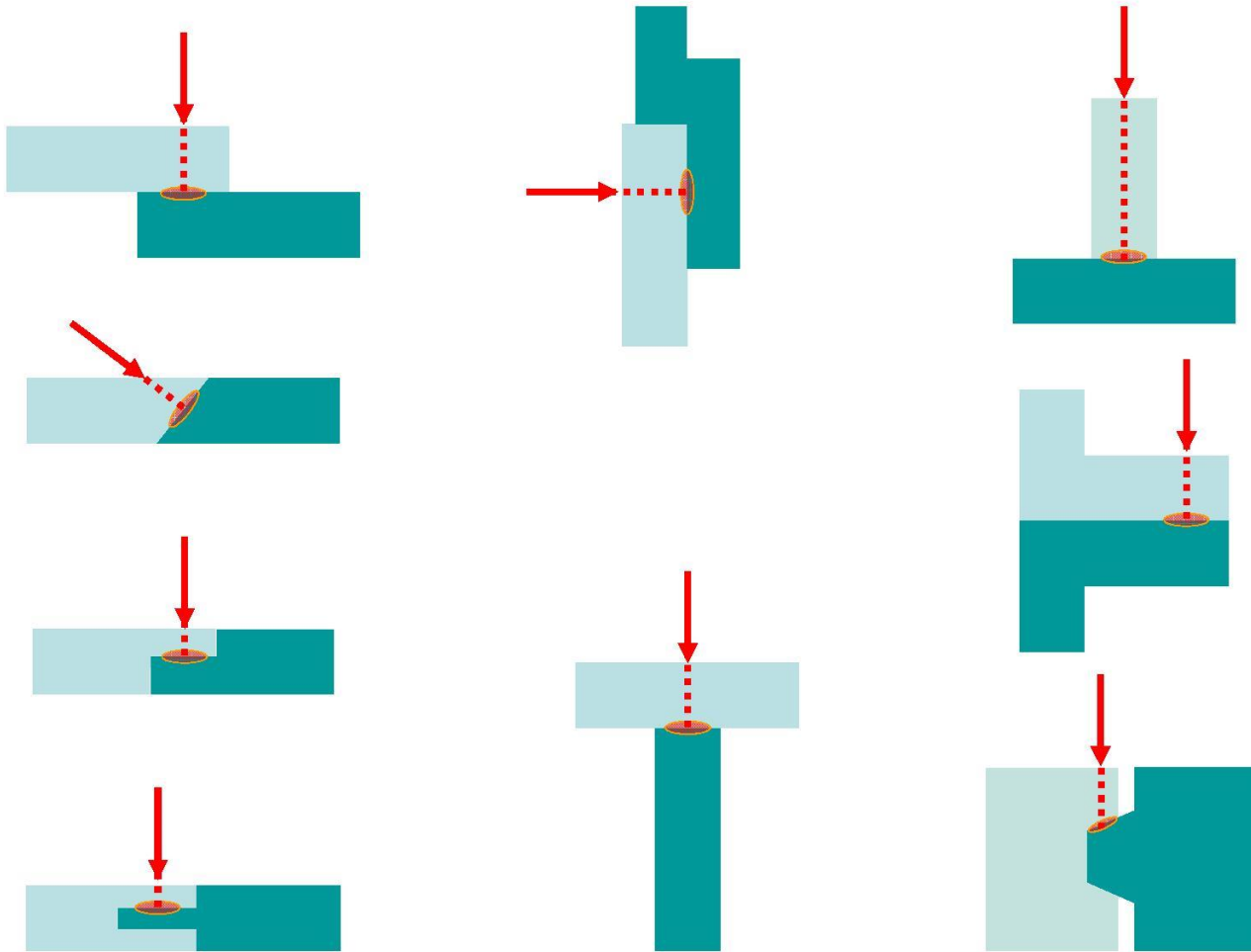
Influences

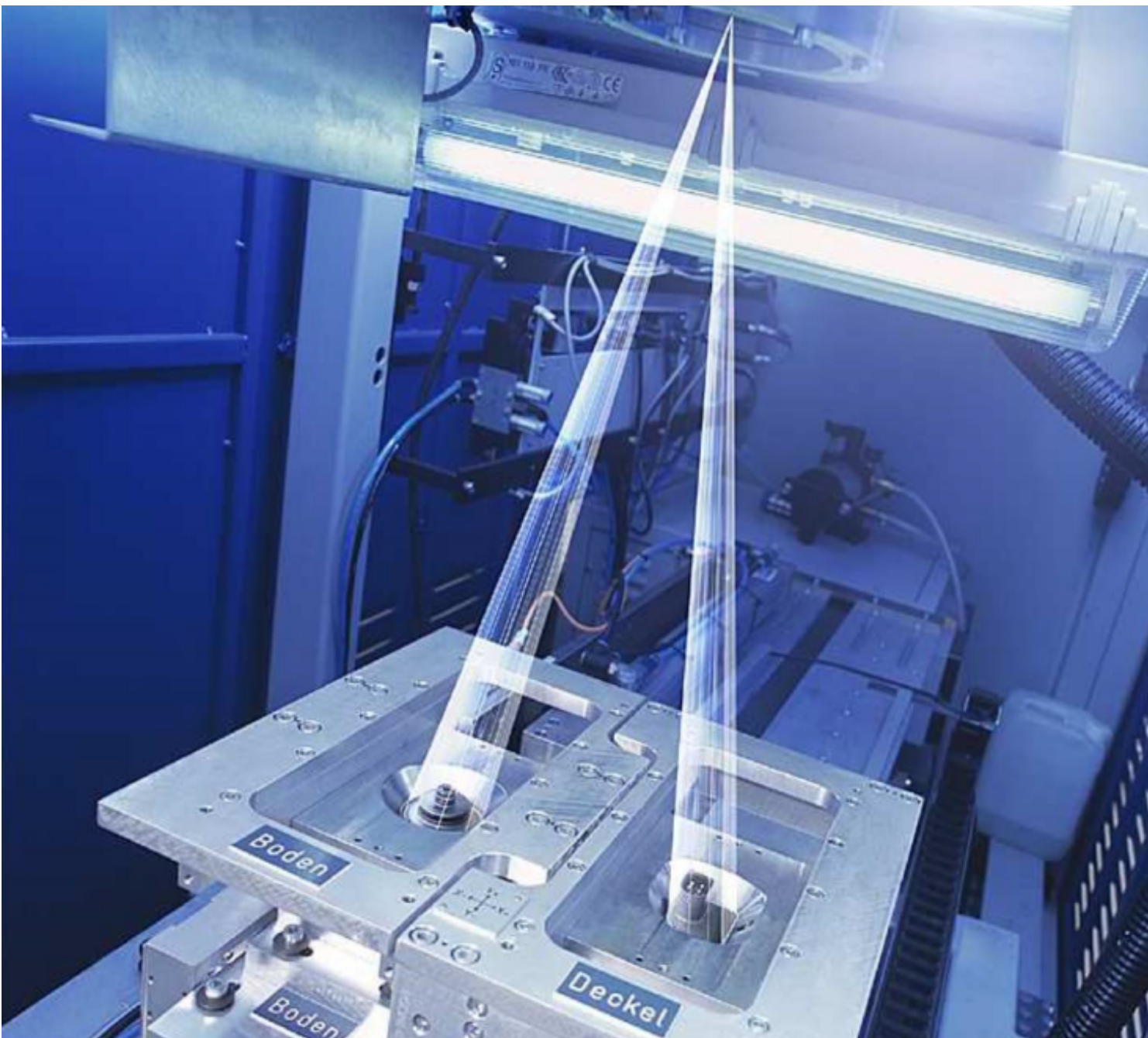
- Clamping force
- Gap between parts
- Viskosity of the melt
- Heat conductivity of the plastic
- Energy intake
- Heat exchange time
- Cooling time (in clamping position)



Welded joint

Examples for weld line designs





Optical accessibility

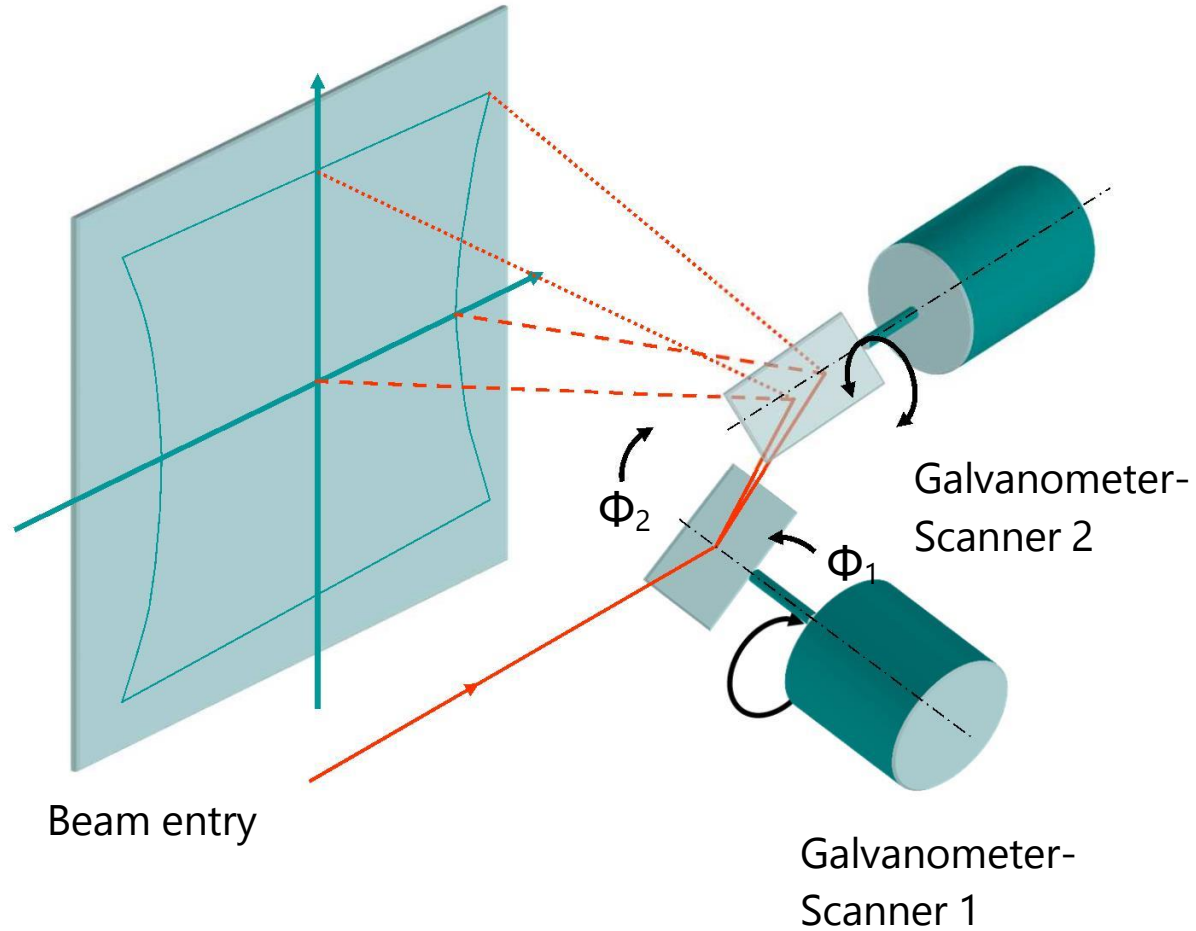
Machine and tool settings

Melting time	Welding time*
Cooling time	Holding time*
Melting distance	Welding penetration*
Force	Welding pressure**
Laser power	Laser power
Penetration speed	N/A
No. of scans	N/A
Scan speed	Scan speed

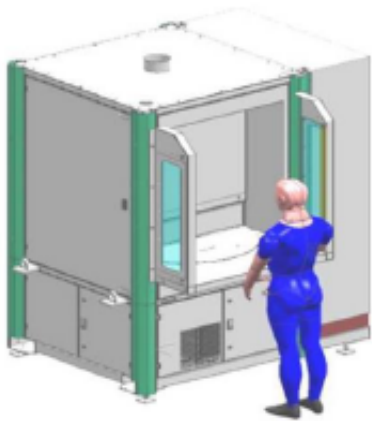
Quasi simultaneous welding

Detail of the scanner head

Beam deflection in X- and Y-direction



Short checklist for laser projects



Part

- Geometry and size
- Leak tight demand?
- ... further conditions?

Machine

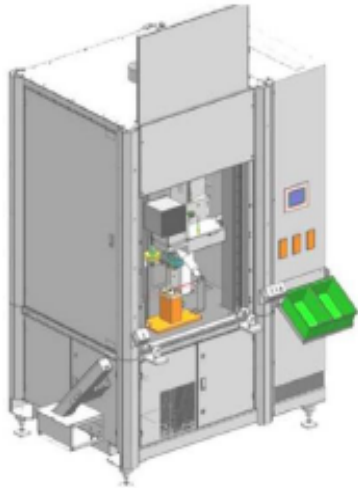
- Laser source
- Number of variants or parts
- Planned number of parts (per year)
- Operating standards
- ... further conditions

Time schedule

- Design Freeze
- Planned SOP

Machine concept

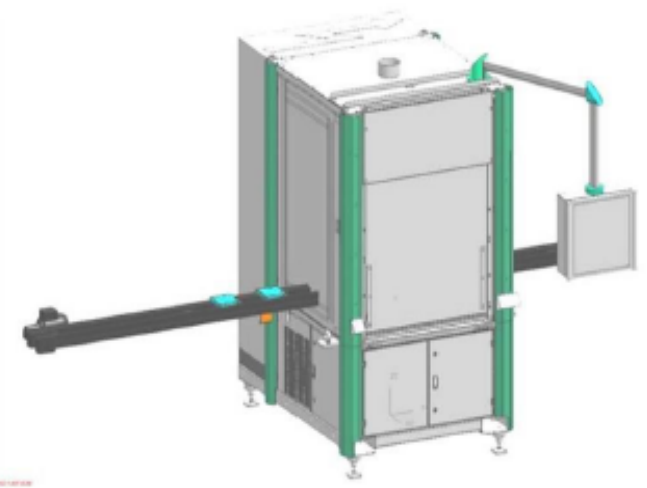
The following criteria is determining the machine concept



- Parts per hour /year
- Part size
- Material



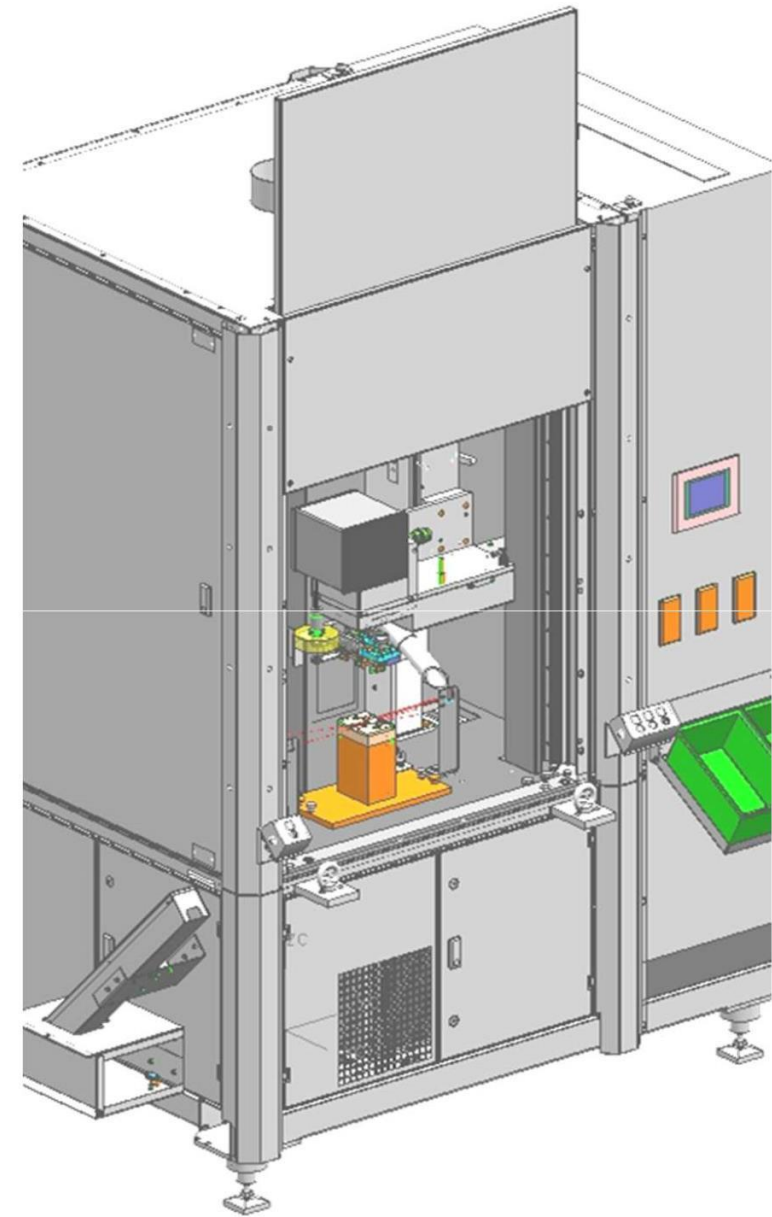
- Design of the weld line
- Welding / cooling / cycle time



- Degree of automation
- Loading concept
- Frequency of tool / product changes

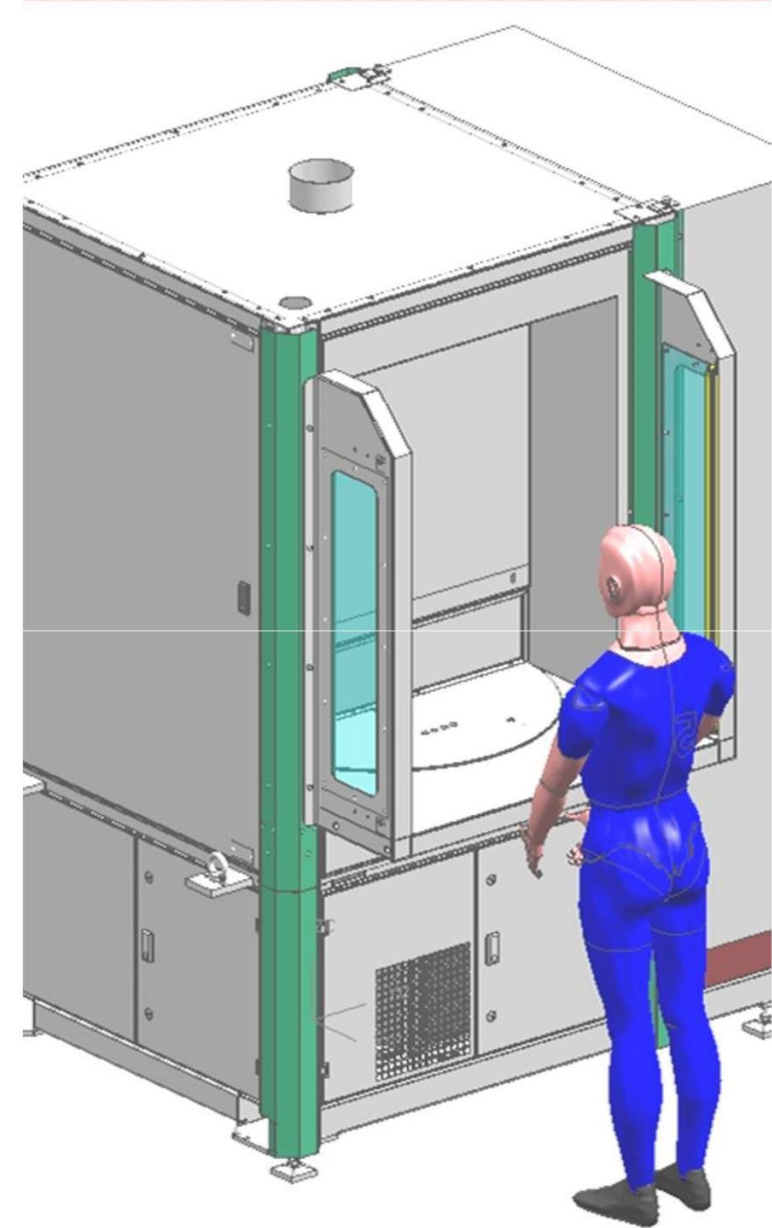
Machine concept

Variable	
Properties:	Manual or fully automatic loading and unloading Clamping system 1 or 2 times Path measuring system Height adjustable laser portal
Parts / shift [8h]	max. ca. 1.400
Cycle time per part [sec]:	min. ca. 20
Part spectrum:	Small parts Large parts Many variants



Machine concept

Rundtisch	
Properties:	Manual or fully automatic loading and unloading Integrated dial table Clamping system 1 or 2 times Path measuring system Height adjustable laser portal
Parts / shift [8h]	max. ca. 2.500
Cycle time per part [sec]:	min. ca. 12
Part spectrum:	Small parts Large parts Many variants





Airbag sensor



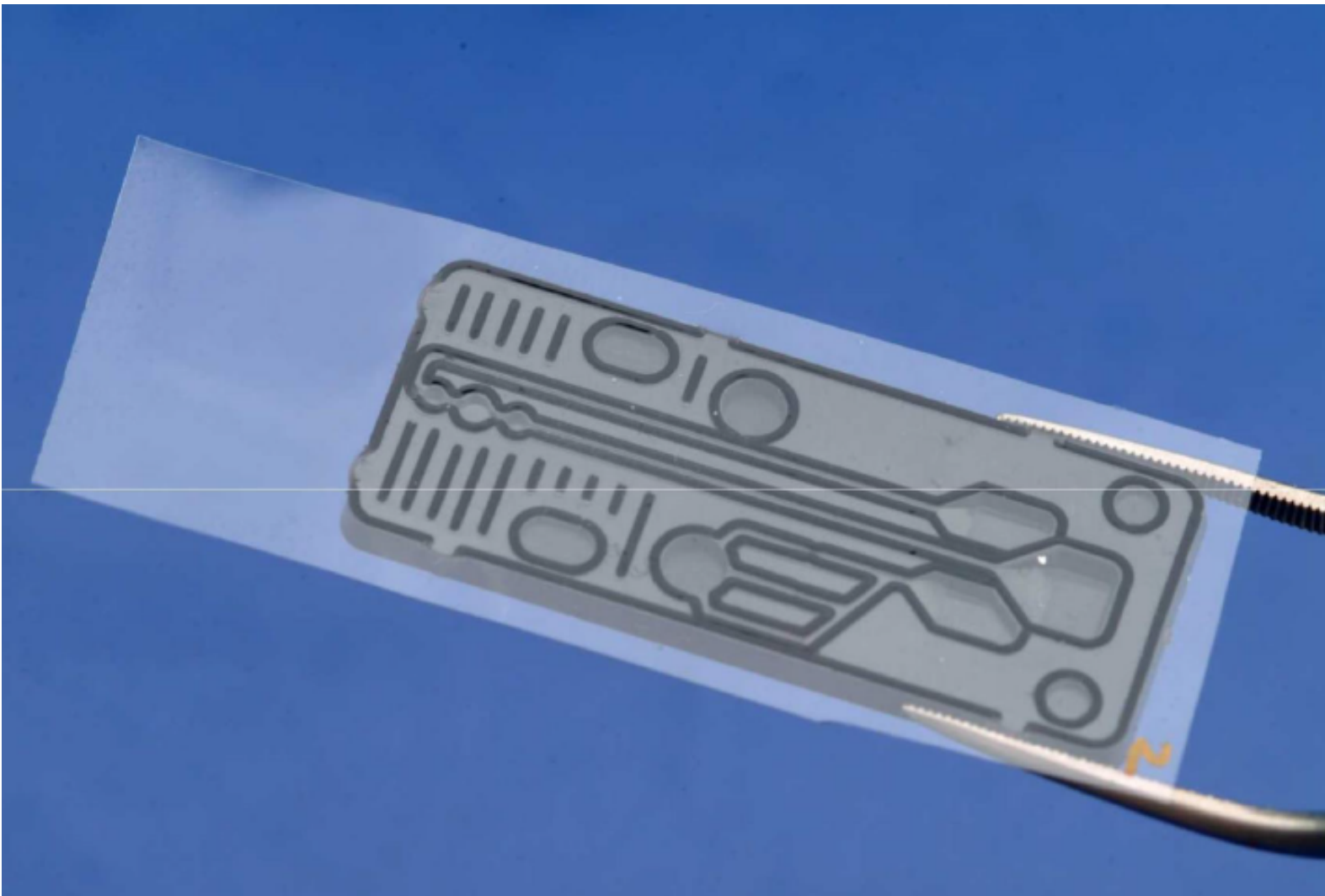
Oil sensor



Diesel heater



Leakage tester



Medical Part:

Micro fluidic component

- Material:
- Transparent part: PMMA
- Absorbing part: PMMA
- Weld process: TWIST
- Laser source : fiber laser
- Laser power: 5 W
- Line length: 650 mm
- Feed rate 250 mm/s

Laser welding is a good choice when high quality welding is necessary:

- Low cycle time
- Fast product change
- Good weld line appearance / cleanliness
- **Small HAZ**
- **No Shocks**
- **No pollution**
- **Leak tight**

