Ybridio

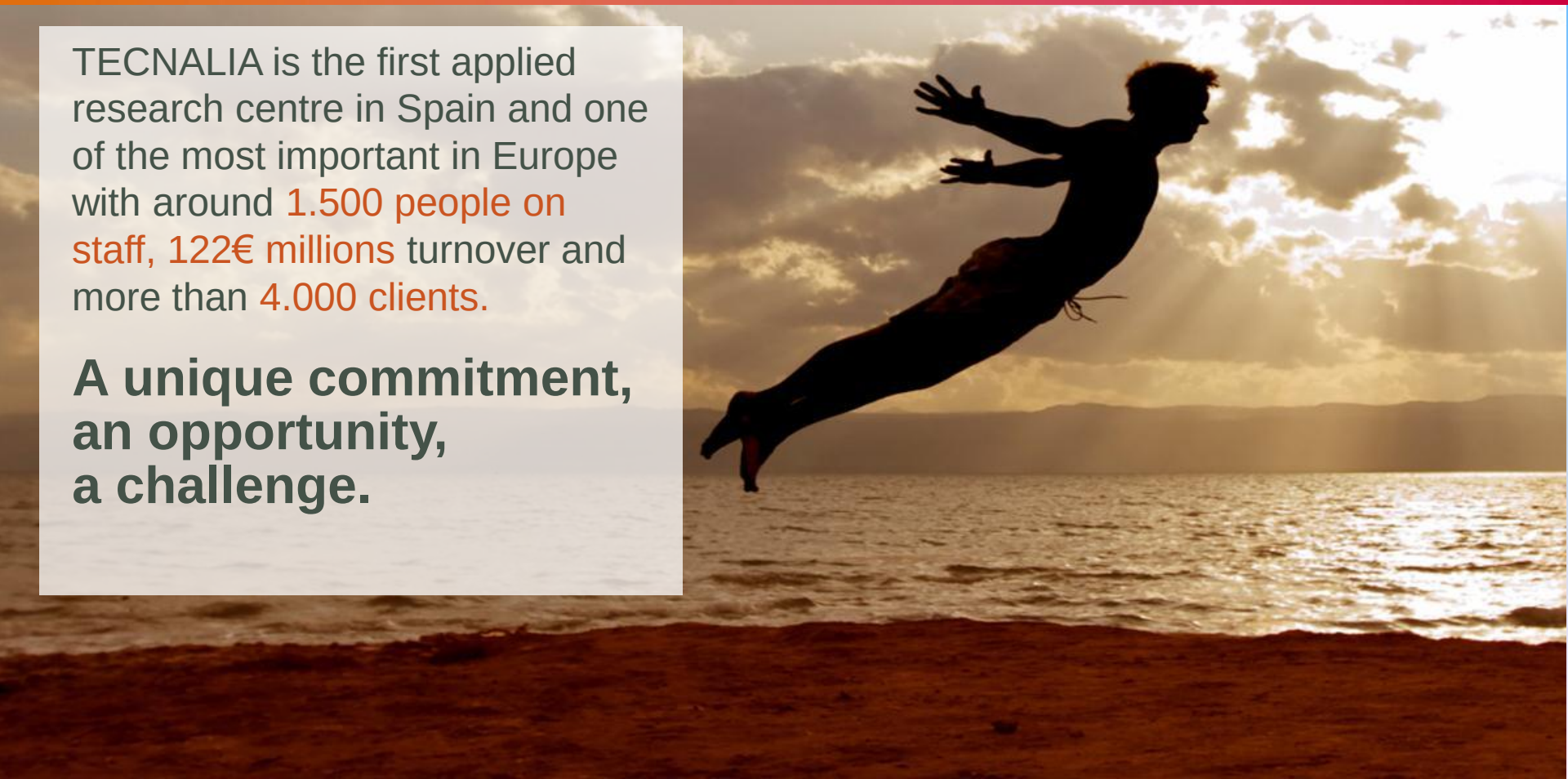
JOINING PROCESS OF DISSIMILAR COMPOSITE-METAL MATERIALS BASED ON LASER TECHNOLOGY

SEVENTH FRAMEWORK PROGRAMME

. ABOUT TECNALIA

TECNALIA is the first applied research centre in Spain and one of the most important in Europe with around 1.500 people on staff, 122€ millions turnover and more than 4.000 clients.

A unique commitment, an opportunity, a challenge.

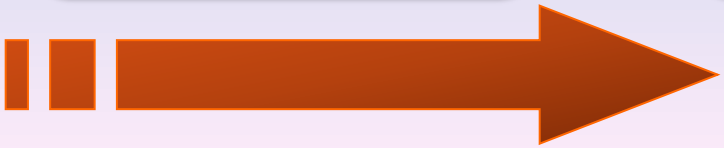


.Positioning

Research and Development Technological Center

Positioning **between** Fundamental Research (University) and Industrial Application (Company)

LABS AND UNIVERSITIES	TECNALIA	COMPANY
• 100% subsidized • Fundamental research • Horizon to 10 years • Scientific production	• Private – Non-profit • Development and technology transfer to the company • Horizon from 2 to 5 years • Impact on customers competitiveness	• Market and Competition • Products and Services • Horizon from 2 to 3 years • Benefits



Organized in 7 Business Divisions: we work from the experience and the expertise in each of the markets in which we operate, with an efficient and proactive attitude.

SUSTAINABLE DEVELOPMENT

INDUSTRY & TRANSPORT

ICT - European Software Institute

HEALTH

INNOVATION STRATEGIES

TECHNOLOGICAL SERVICES

SUSTAINABLE BUILDING

SEVENTH FRAMEWORK PROGRAMME

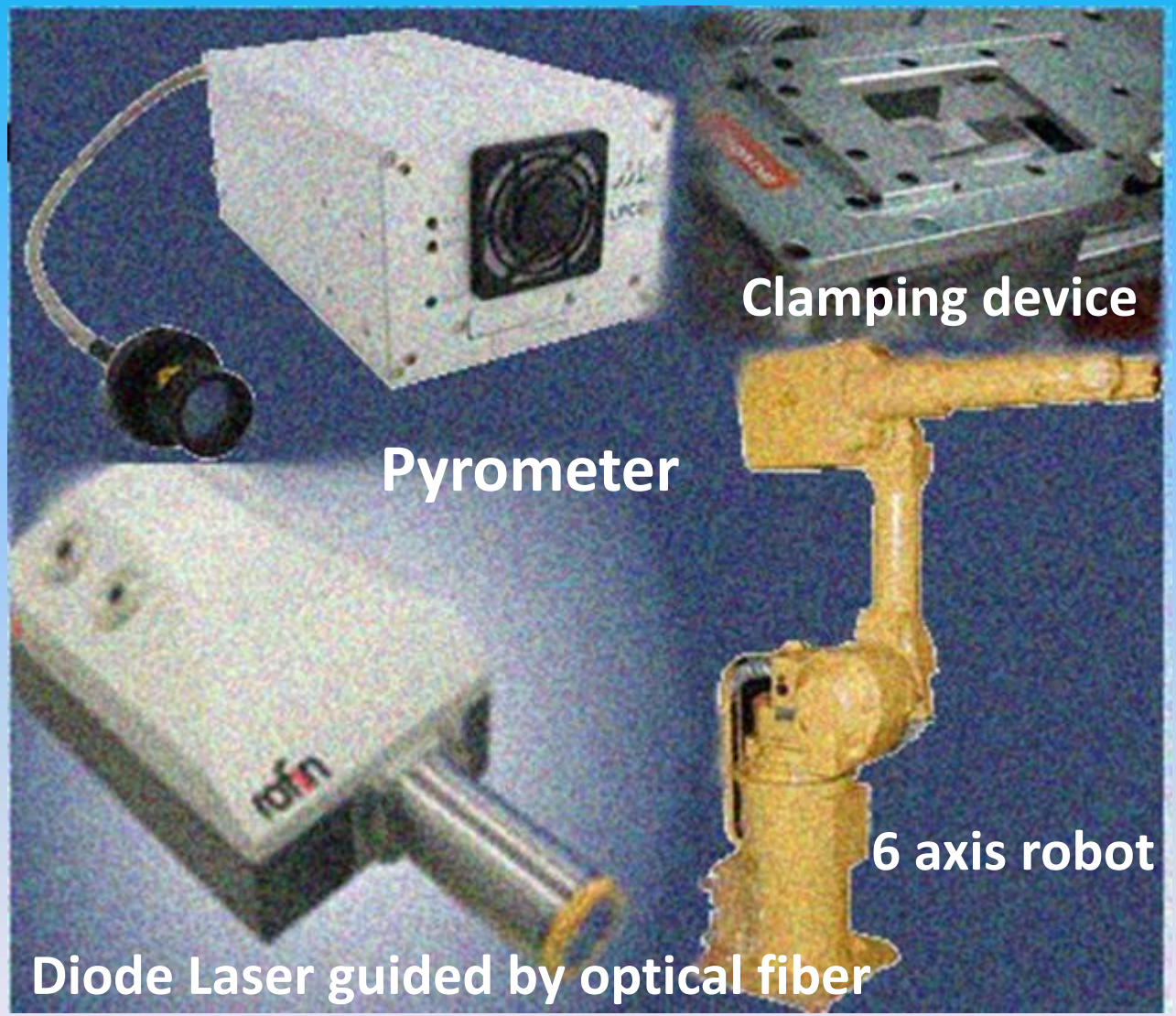
INDEX

- Installation /Parameters to control
- Material selection
- Experimentation method for laser joining
- Results of laser joining
- Next steps

Safejoint Workshop

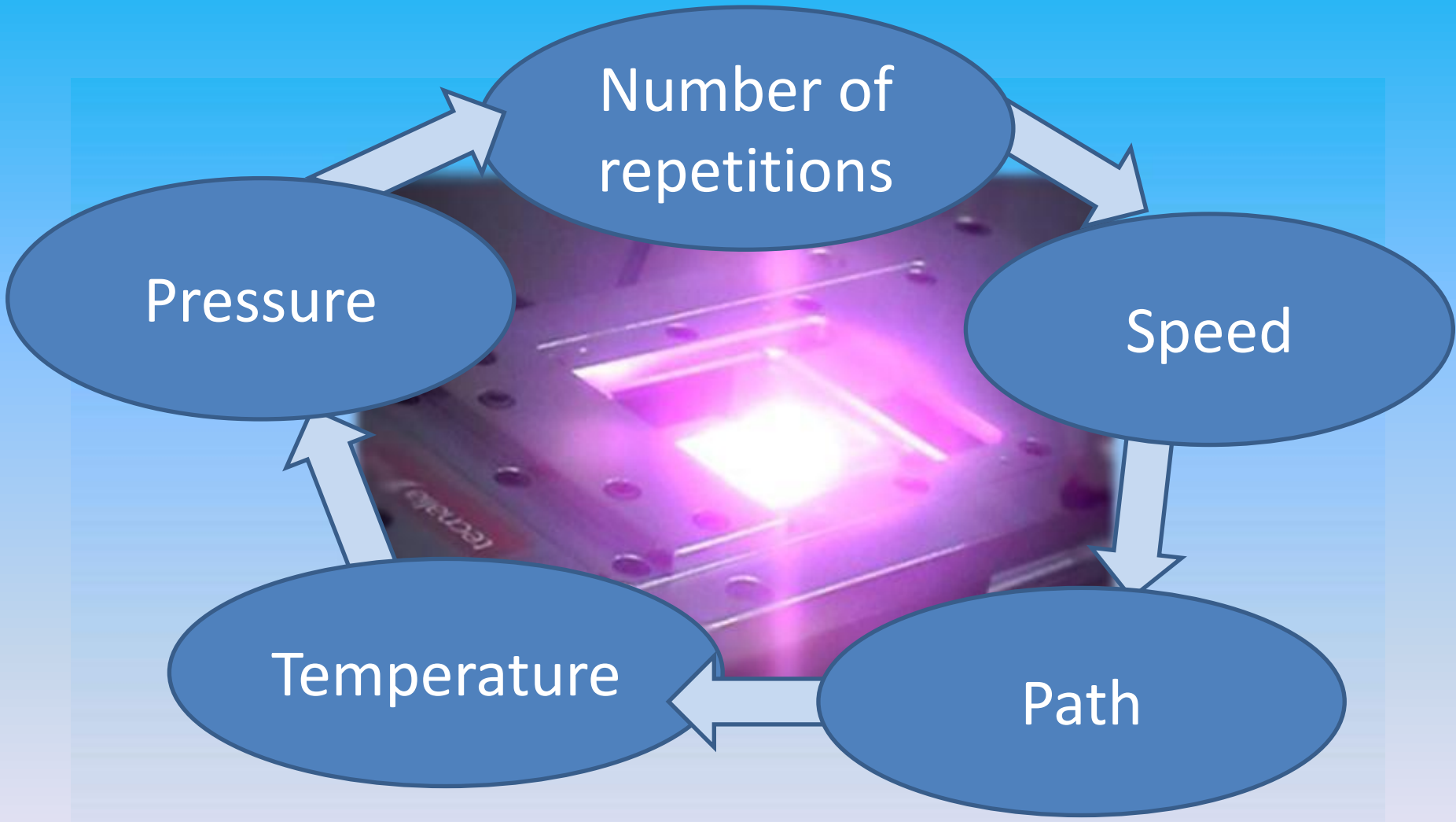
2nd-3rd July 2014

Installation



Ybridio

Parameters to Control



SEVENTH FRAMEWORK PROGRAMME

TEMPERATURE CLOSE LOOP CONTROL

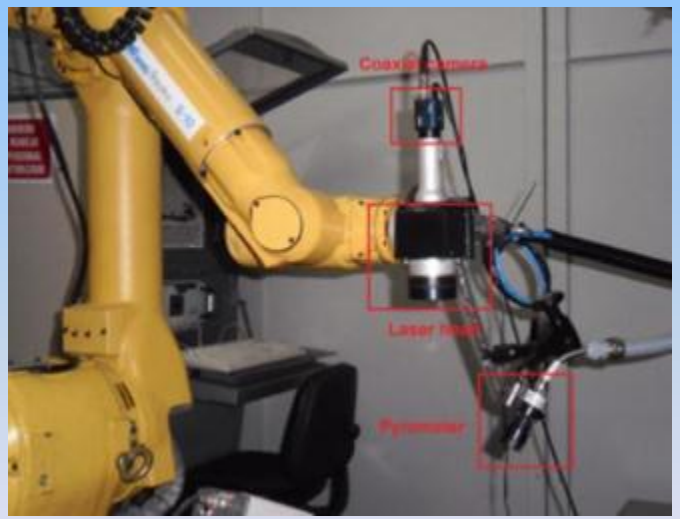
Positioning the pyrometer in the "exact point" by the aid of a coaxial camera.

The pyrometer measures dynamically the temperature between the plastic and the metallic material during the joining process

The measurements are compared with the desired set point

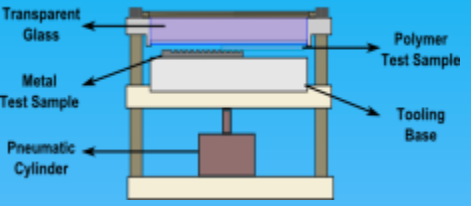
Depending on the error, the power output of the laser is calculated

The power (analog output) is sent to the laser controller



Parameters to control

PRESSURE

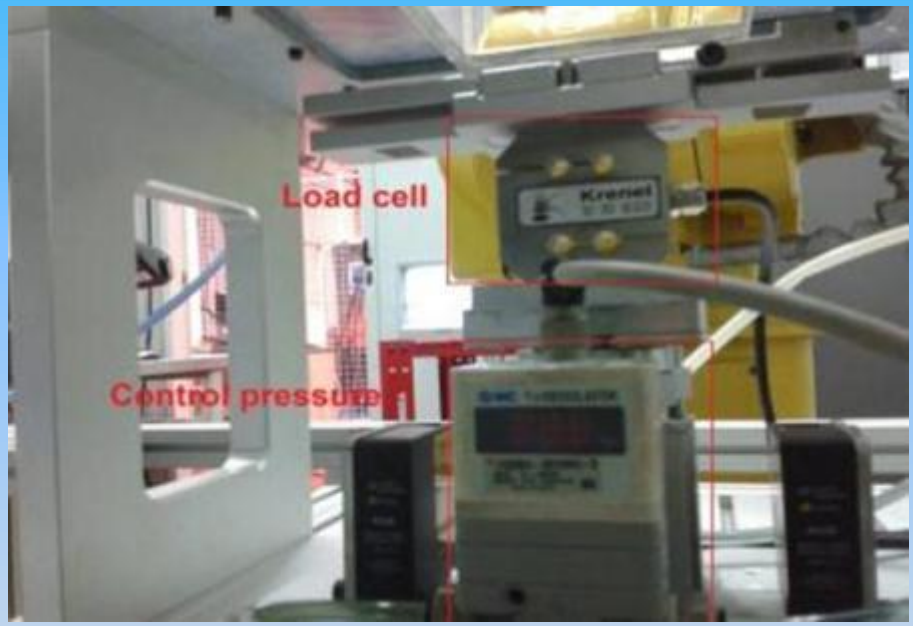


Clamping device v1.0

Main issues

- The parts move when closing the clamping device
- Not controlled pressure

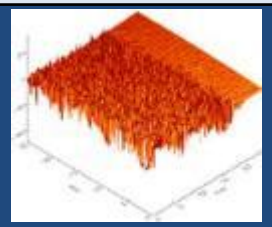
Clamping device v2.0



- Pressure rise ramp
- Controlled pressure

Material selection

	Steel	Aluminium	Titanium	Textured
Pure PP				
TEPEX 102: PA6+47%GF with and without colorants				
TEPEX 101: PA66+45%GF				
TEPEX 104: PP+45%GF with colorants				
GMT: PP+23% short fiber				
PA66 with glass fiber (0-35%)				
Suprem AS4: PEEK Unidirectional Carbon Fiber				
TohoTenax: PEEK Fabric Carbon Fiber				



Blue: Done
Red: To do

Experimentation method for laser joining

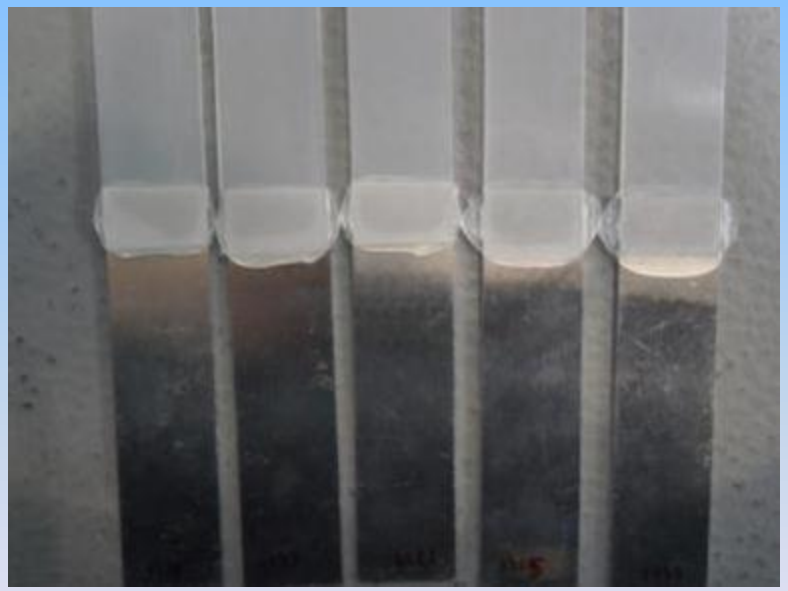
Ybridio

tecnalia Inspiring Business

Results of laser joining

Pure PP + Sand Blasted Aluminum

- There are materials with very low adhesion
- It is a material that flows during the joining
- Mean strength : 1015N for 2mm PP+ 2mm Aluminum →3,2MPa



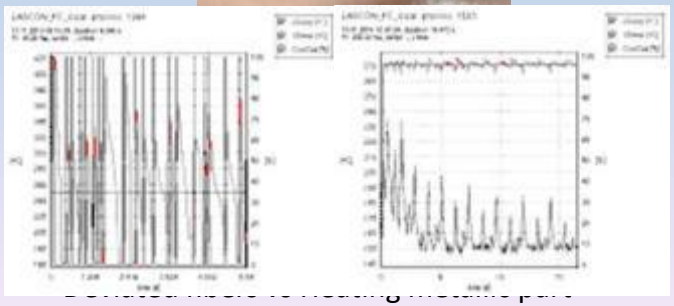
Bonding area: 300 mm^2

- Applying more pressure, the welded area is bigger, but the quality results are not better.
- The best results are obtained with medium pressure (50Kg), medium speed (50mm/s), and 2 repetitions (total cycle time=4,8seg)

Results of laser joining

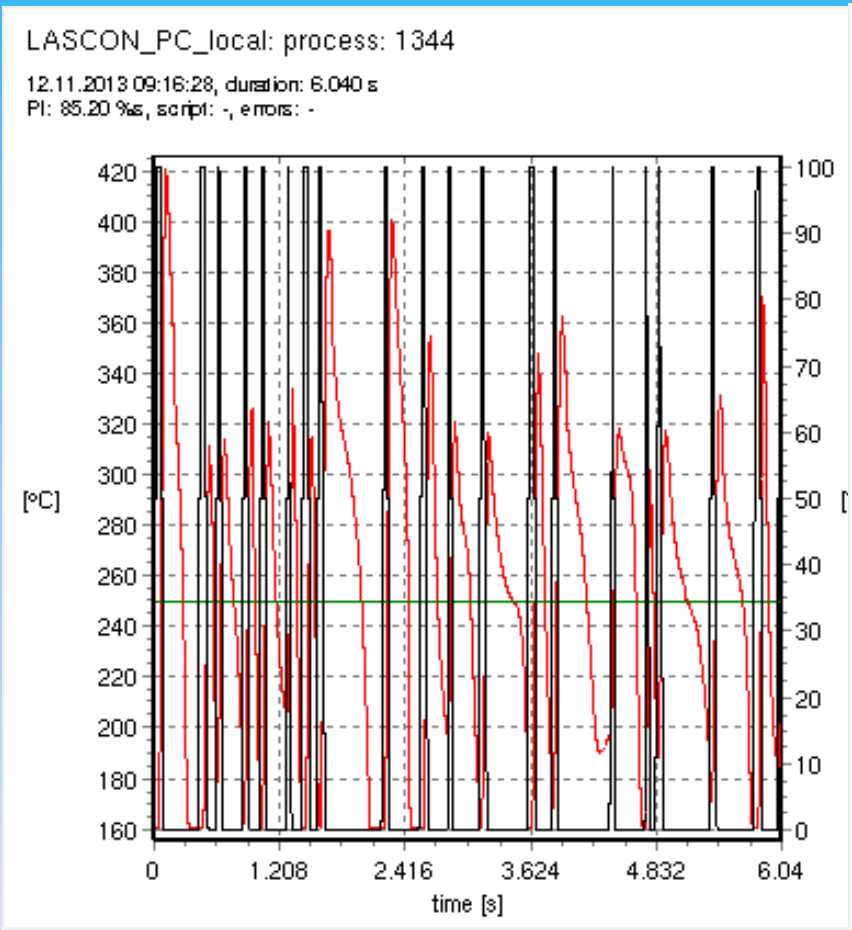
TEPEX+ Sand Blasted Steel

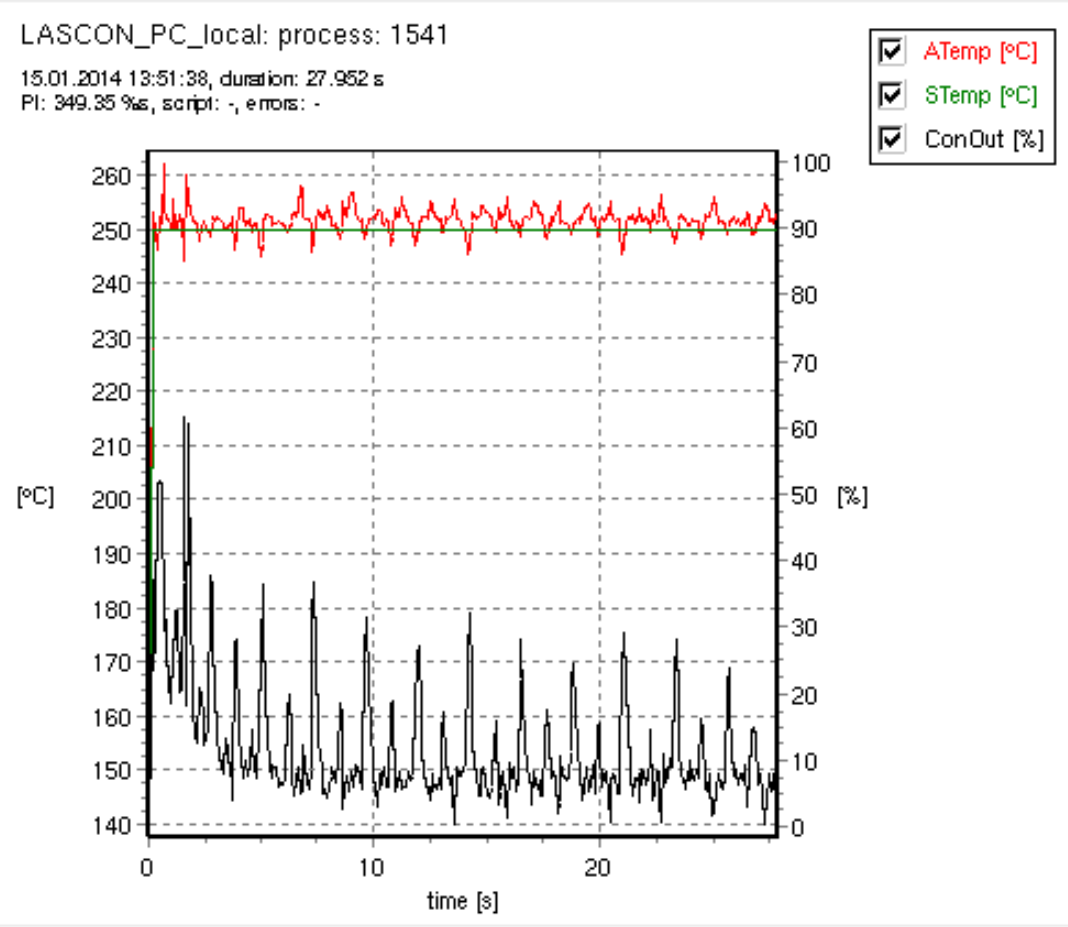
- Black TEPEX is not possible to be joined by transparency.
- 1mm natural TEPEX joined by transparency. 2mm thickness or higher not possible.
- Holes are not useful to join by transparency. The pyrometer does very bad regulation and the material does not weld or is degraded .
- It is possible to join TEPEX with and without colorants by heating directly the metallic part, but the cycle time increases almost x3 (6s -17s)
- Maximum strength :
  - 4787N for 1mm TEPEX 102 (PA6) →15,3 MPa
  - 4932N for 1mm TEPEX 101 (PA6.6)→ 15,8MPa
  - 2515 N for 2mm TEPEX 104 (PP) →8 MPa



Results of laser joining

TEPEX+ Sand Blasted Steel



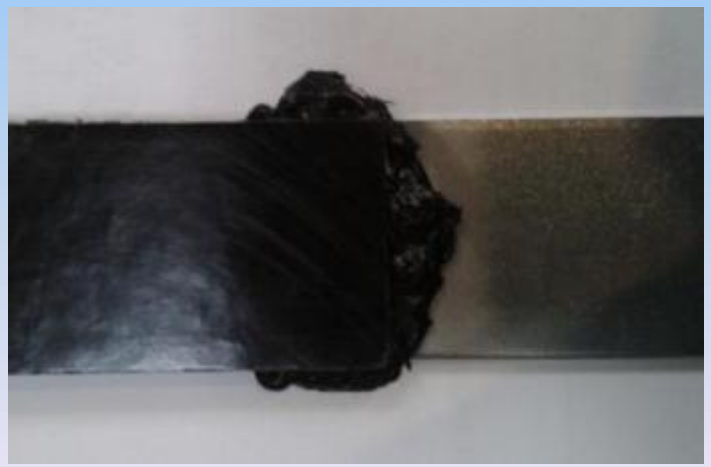


Deviated fibers vs Heating metallic part

Results of laser joining

GMT+Sand Blasted Steel

- It is possible to join 4,8mm GMT by heating directly the metallic part.
- This material have got short fibers and flows a lot during the welding. So it is a candidate material for macro textured parts.
- Maximum strength obtained with sand blasted Steel:
  - 2170N for 4,8mm GMT (PP) → 6,9 Mpa



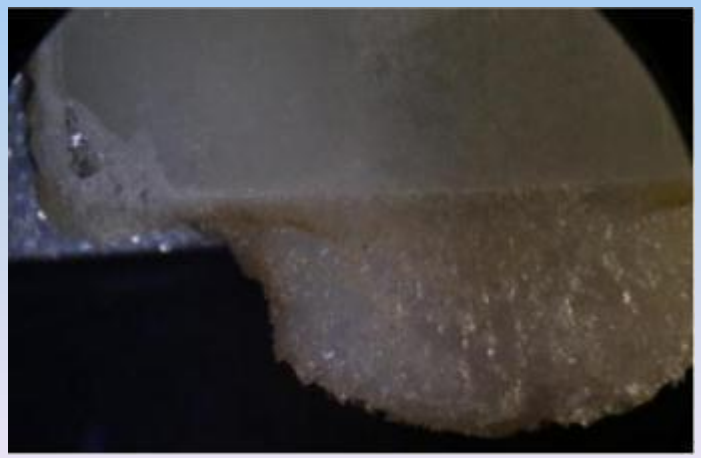
Results of laser joining

PA66 0-35%GF (1.6mm thickness) +Sand blasted Steel

- It is very easy to burn the material→ The control temperature is very important for this material.

- Due to the fiber glass, the control temperature is tricky and usually produces burns. The first trials shows that it is possible to join PA66 with 20% GF but no 35%GF. Best parameters still to be found.

- For PA66 35%GF , the first test shows better lap shear test results for degraded material



- Maximum strength :
  - 2867N for 1.6 mm PA6.6+ 2mm Steel→ 9,2 Mpa
  - 3157N for 1.6 mm PA6.6 35%GF+ 2mm Steel → 10,1 Mpa

Results of laser joining

PEEK+Aluminum or Titanium

- It is possible to join Suprem AS4 PEEK Unidirectional Carbon Fiber and TohoTenax Carbon Fiber PEEK Fabric with Aluminum and Titanium by heating directly the metallic part.

- For aluminium is necessary to use higher laser power

- Maximum strength :
  - 2493N for 1.6mm Suprem AS4 (UD) + 2mm Titanium → 8 Mpa
  - 2865N for 1.6mm Toho Tenax+ 2mm Aluminum → 9,2 Mpa

NEXT STEPS

- **To optimize the new clamping device and develop a new software interface.**
- **Higher energy consumption and cycle time of parts joining by heating directly the metallic surface→ To improve the results for each material**
- **To test other textures and/or the combination of sand blasting with macro textures**