SONATS

Europe Technologies group

Innovative impact surface treatment solutions

Organization and Key Figures

With more than 25 years of experience, Europe Technologies group offers you its expertise for:

- **Industrialization and manufacturing of composites and metallic parts**
- **Design and manufacturing of robot cells and machines integrating our processes (metal surface composite welding, cutting, sanding…)**
- **International MRO services (airplanes, vessels, …)**

Organized in 3 main business activities : **Engineering – Technologies – Manufacturing,** we support our customers from **R&D to industrialization** of parts and processes.

Key Figures 2017

400
(employees)

70 M€
(Turnover)

8 subsidiaries
(20000 m² of buildings)

35%
(Export)

15%
(R&D investments)

Main Business Activities

Engineering

AIC

- Engineering / Industrialization / Industrial transfert of parts
- Intellectual services *(design, preparation, supply chain, etc.)*
- Machining programming and simulation

CRYOGENIC CONTAINMENT

- Solutions for gas-as-a-fuel : bunkering and propulsion (LNG and H2)

Manufacturing

ORATECH

- Composite parts manufacturing
- Composite and metal machining
- Toolings

Technologies

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- Shot peening, needle peening and forming (straightening) by ultrasonic process for metal parts
- Residual stress measurement
- MRO services

SONIMAT

- Plastic welding : ultrasonic, spin, laser, hot plate and infrared processes
- Ultrasonic slicing and cutting

GEBE2

- Robot cells for composite and metal parts finishing
- Assistance exoskeletons and zero-gravity arms support

SERVISOUD

- Mobile welding carriages
- Location and sale of welding accessories and equipments

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Who we are

CREATION

1991

SUBSIDIARY

1998

Europe Technologies Group

LOCATION

Headquarters in Nantes (FR) & Sister Company in USA and China

EMPOWERING TECHNOLOGIES

ACTIVITIES

Innovative in Mechanical impact surface treatments

CERTIFCATIONS

SONATS Quality
ISO 9001 & **EN 9100**

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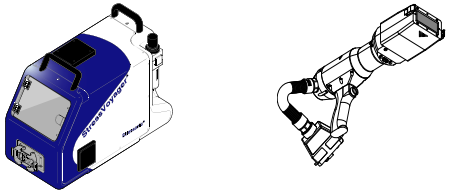
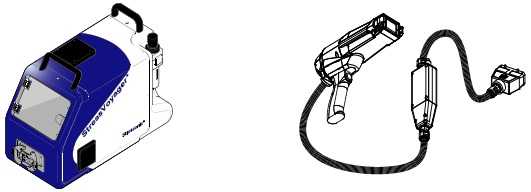
Our Solutions

Standard mobile equipment

Stress-Voyager for Ultrasonic shot peening



Stress-voyager for Ultrasonic needle straightening



Nomad for Ultrasonic impact treatment

Customized machines

Robotized machines for ultrasonic shot peening

Automated machines for ultrasonic shot peening

Material & Shot Peening measurement

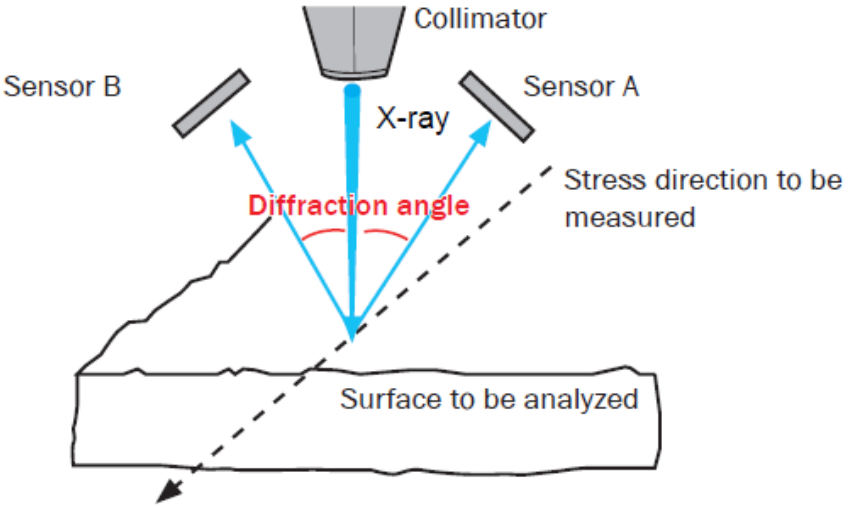
X-Ray Diffraction

Hole Drilling

Eddy current, Contour Method
Roughness, Hardness…..

Material & Shot Peening measurement

XRD



X-ray Diffraction
NF EN 15305 and ASTM E2860

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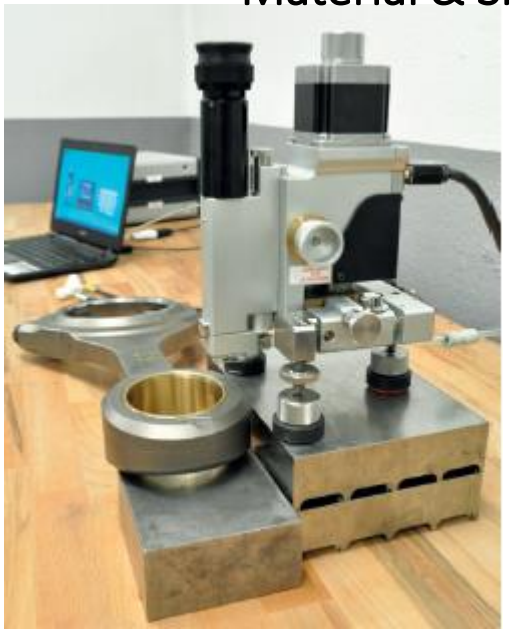
Material & Shot Peening measurement

Hole-Drilling
Strain-Gage



Hole-Drilling Strain-Gage method
ASTM E837 and Sonats advanced analysis

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Material & Shot Peening measurement

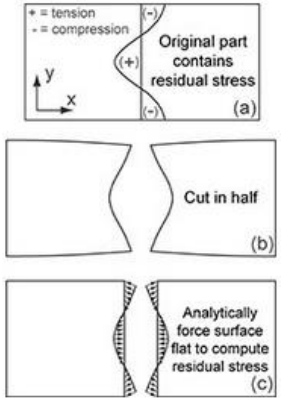
Metallography and Roughness

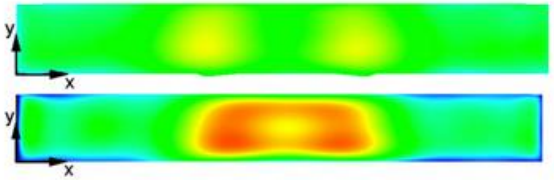
- Metallurgical characterization (microstructural change, deformation thickness, cracking, corrosion, porosity)
- Roughness and topography measurement (EN ISO 4288)
- Hardness by Vickers (EN ISO 6507) and Knoop (EN ISO 4545) testing

Material & Shot Peening measurement

Contour method

The contour method is a destructive test to measure residual stresses.





Eddy Current

Permit to check the quality of the part in a few seconds on production

- The Residual Stresses
- The Almen Intensity
- The coverage

Stressonic® Technology

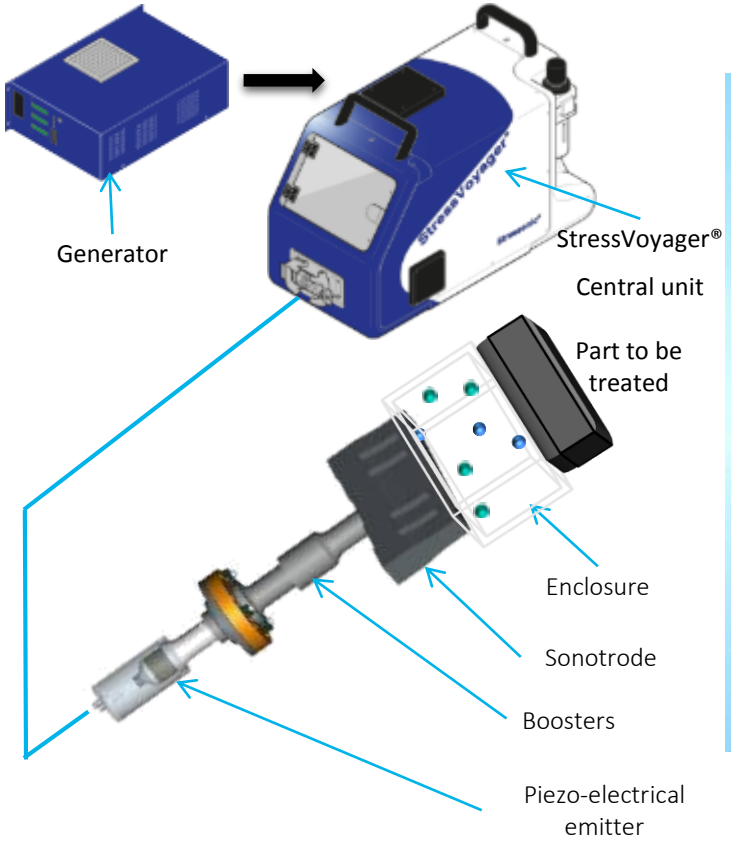
Process

Ultrasonic Shot Peening
USP

Forming & Straightening
UNS

High frequency mechanical impact
HFMI/UIT

Stressonic® Technology



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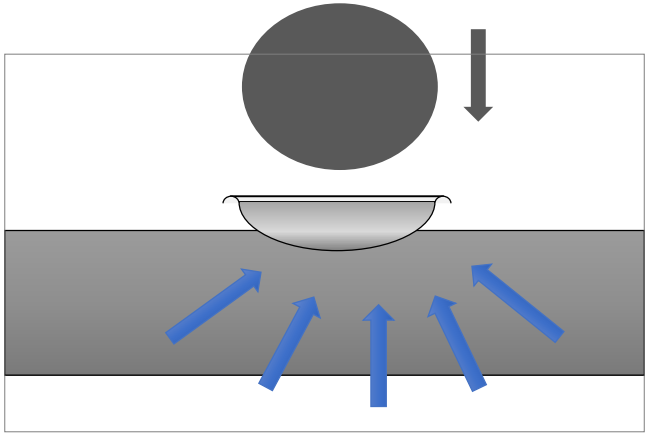
Ultrasonic Shot Peening

SHOT PEENING

Cold working impact treatment, consisting in shocking a metallic part surface with spherical media, aiming at modifying its surface characteristics.



Uses on most seen metallic and ceramic materials: **Steel, Aluminum, Titanium, Inconel, Stainless Steel, Zirconium, …**

Why uses shot peening?

1/ Improves fatigue life and parts reliability

2/ Enhances stress corrosion cracking resistance

Which objectives?

Residual Compressive Stresses Introduction

- Texturing
- Roughness Modification
- Nano-crystallization
- Compaction…

Ultrasonic Shot Peening
Introduction

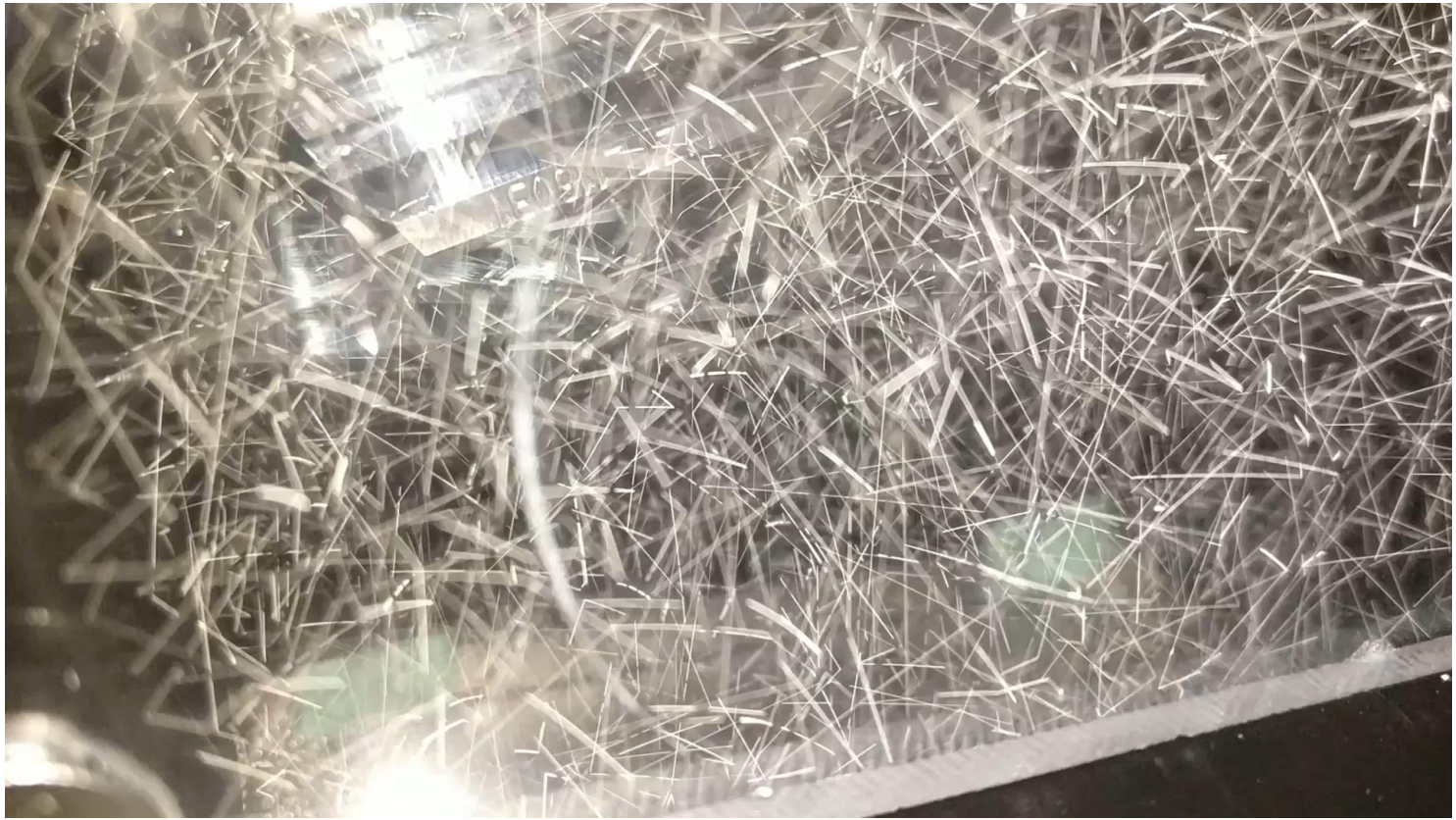
Treatment in the dovetail area for a disk.

(Clear enclosure is only done for visualisation and qualification process)

Even for compexe geometry

Ultrasonic Shot Peening

Introduction



Ultrasonic Shot Peening

Specifications and References

AMS 2580 & 2585 « Ultrasonically Activated Shot peening »

BNAE - NF L 06-833 « Aerospace series -Ultrasonic shot peening for inducement of compressive surface stresses for metallic parts »

AIPI 02-02-004 (Process Instruction) « Shot Peening for Fatigue Life enhancement of metal parts »
AIPS 02-02-004 (Process Specification) « Shot Peening for Fatigue Life enhancement of metal parts »

DMP28_L « Mise en contrainte de compression superficielle »

Aerospace, Space, Military:

Airbus, Dassault Aviation, Eurocopter, MTU Aeroengines, Safran, Saljut, SKF Aeroengines, Ratier-Figeac, Snecma, Turbomeca, Pratt&Whitney, US Army, Xi'An Aircraft Engine

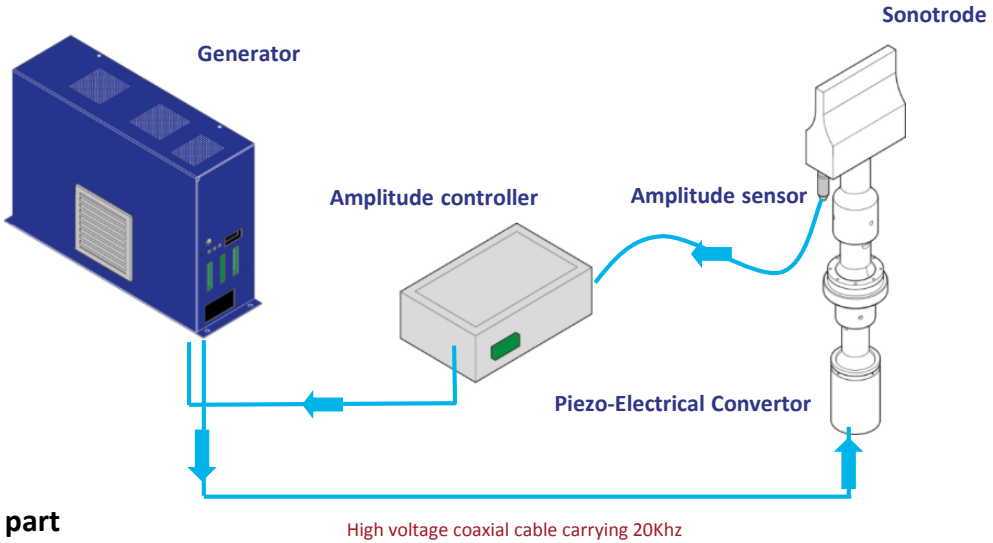
Power Generation, Automotive and Heavy Industries:

Alstom Power, GE Gas turbines, GE Energy, MTU Friedrichshafen, MAN Diesel, Caterpillar, MHI Nuclear, AREVA, Daimler, Linamar, Bosch Turbo, Hilti, ThyssenKrupp, Toyota, PSA, Renault, Arcelor Mittal, L'Orange, SKF, Valeo, Hutchinson, Renault F1

Ultrasonic Shot Peening

Treatment Parameters

- Sonotrode Vibration Amplitude **Controlled in real time**
- Media (material, diameter, hardness, density)
- Media's quantity (counted or weighted)
- Chamber geometry **Distance between Sonotrode and treated part**
- Process time



Media or Beads

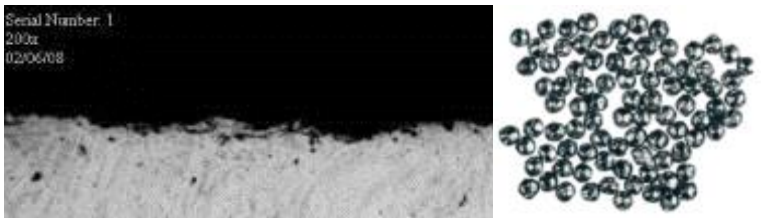
- Only f**ew grams** of beads are necessary

- High quality beads (geometry – ball bearing type, material)

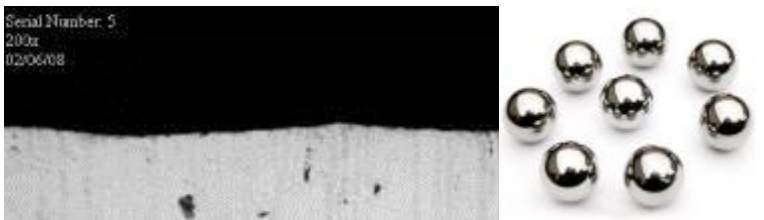
  = **No erosion, only compression.**

- Beads don’t break on the surface enabling no contamination : **No need for surface decontamination** by chemical or mechanical methods, reduction of polishing need.

Example for Aluminium 2000, Intensity 17N *mm*



Conventional Shot Peening (CSP)

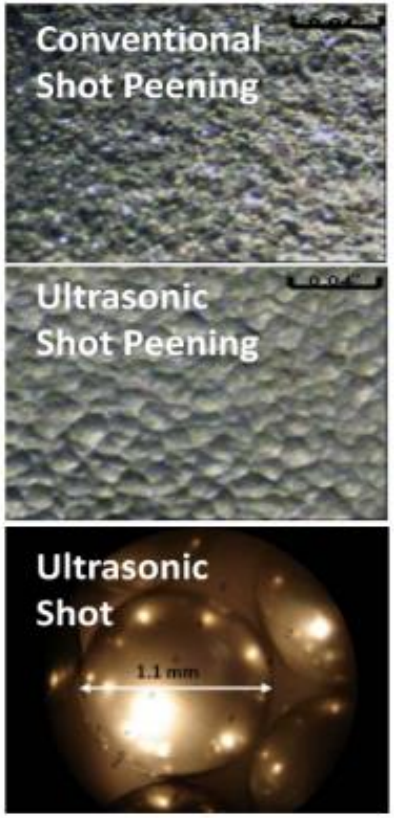


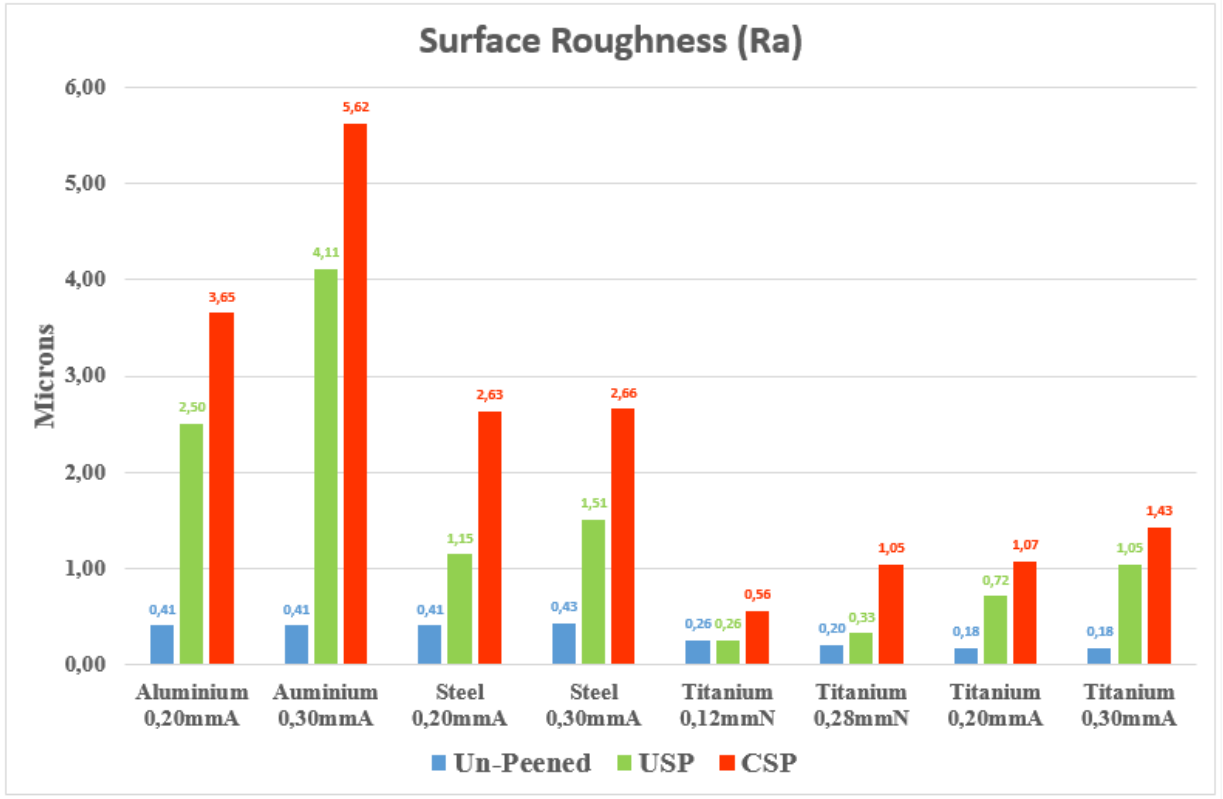
Stressonic® (USP)

Ultrasonic Shot Peening

Technical and Industrial Advantages

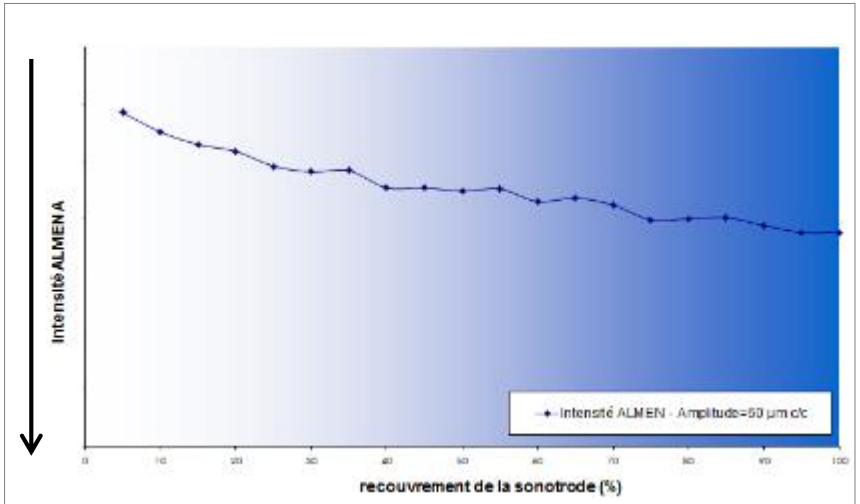
Lower ROUGHNESS after ultrasonic shot peening comparing to conventional methods



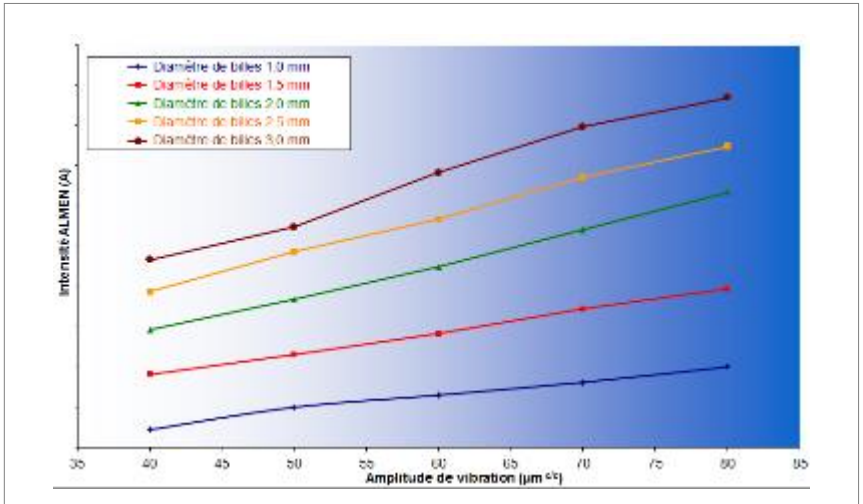


Whole range of almen intensity available

N-A-C Almen Intensities



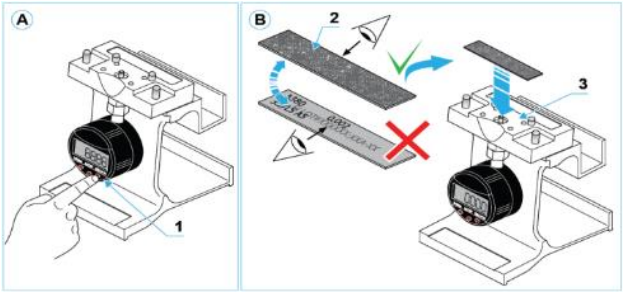
Beads quantity effect on Almen Intensity

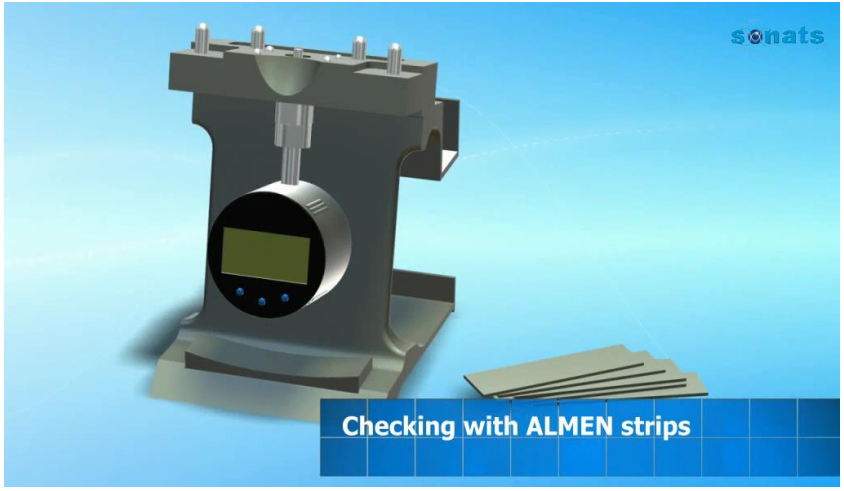


Vibration amplitude effect on Almen Intensity

Intensity control on almen strips

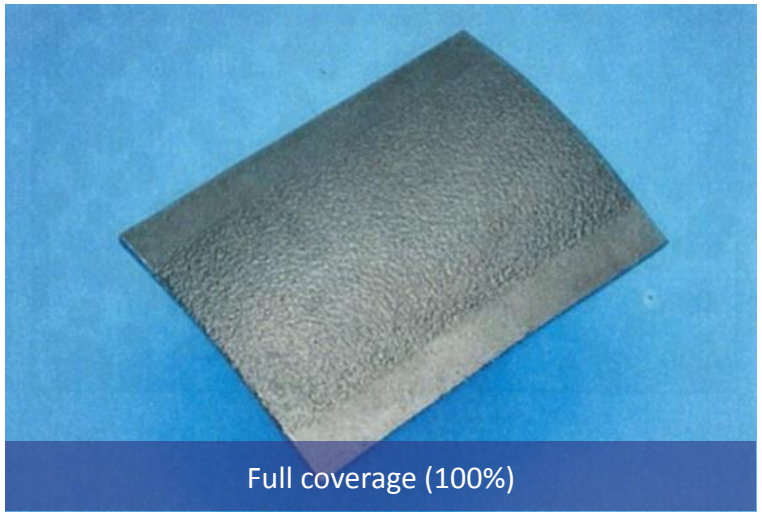
- **Strips positioning** on almen gage
- **Same shot peening conditions** than the part to be treated
- **Observation** of strips distorsion during treatment and measurement with Almen gage
- **Determining of a saturation curve** to calculate shot peening intensity based on a set of parameters



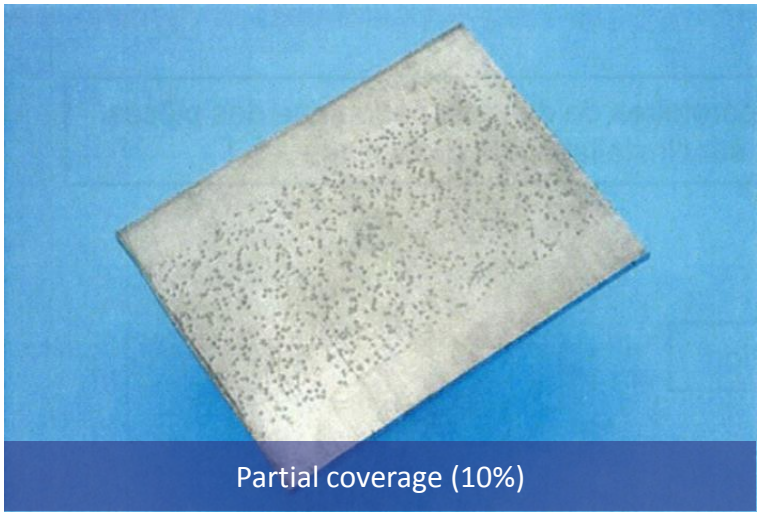


Coverage

Number of impacts measured on an area



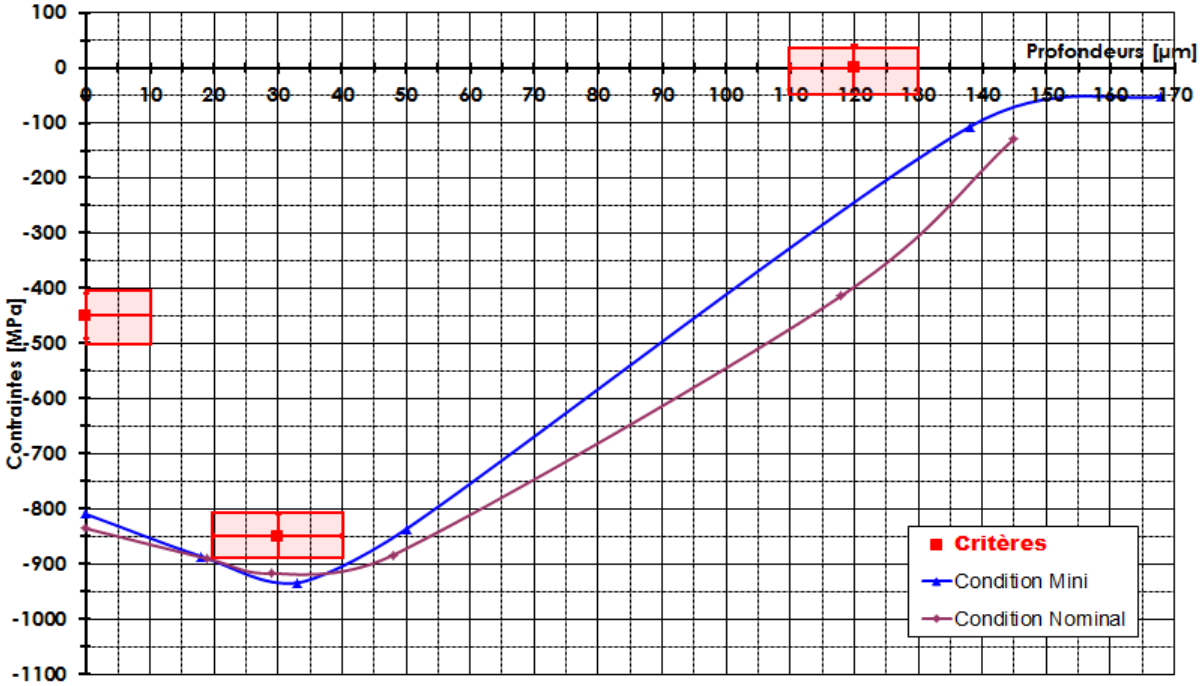
Full coverage (100%)



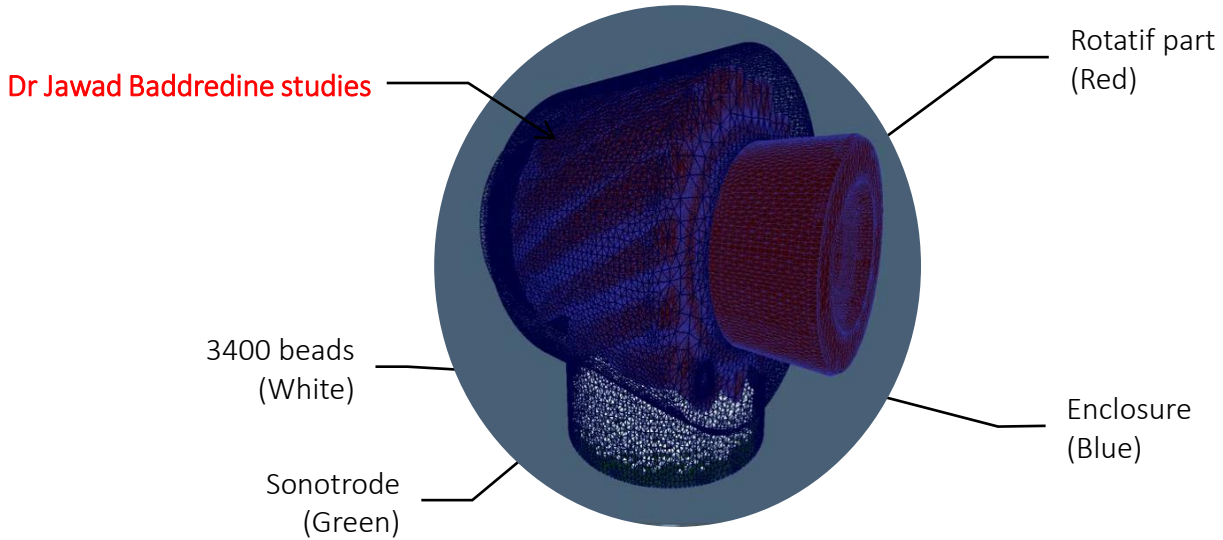
Partial coverage (10%)

Residual stress curve example.

Some customers have requirements such as residual stresses on surface and the peak



Numerized simulation



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Ultrasonic Shot Peening

Portative equipment

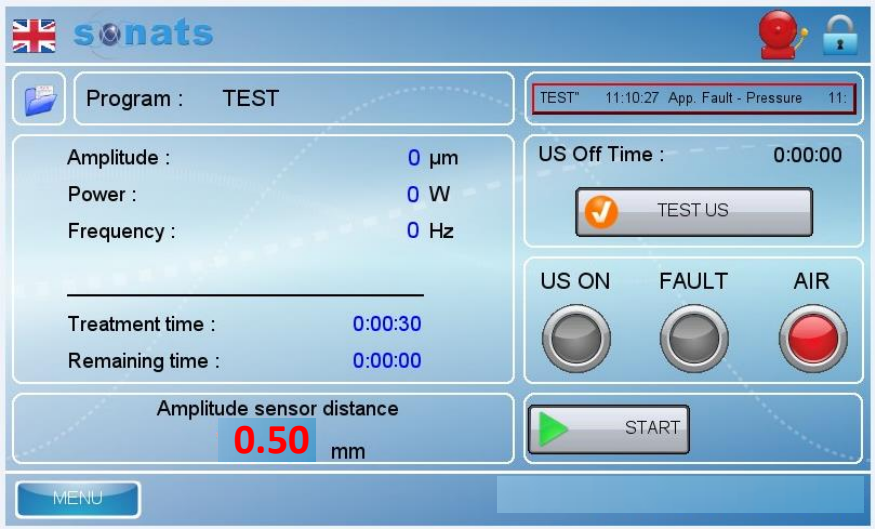
Handheld peening head converts an electrical signal into mechanical energy to throw high quality balls against the part to be treated.

The generator inside the central unit produces an electrical sine wave at ultrasonic frequency. Continuous digital control of the process parameters.

Ultrasonic Shot Peening

Portative equipment

Touchscreen



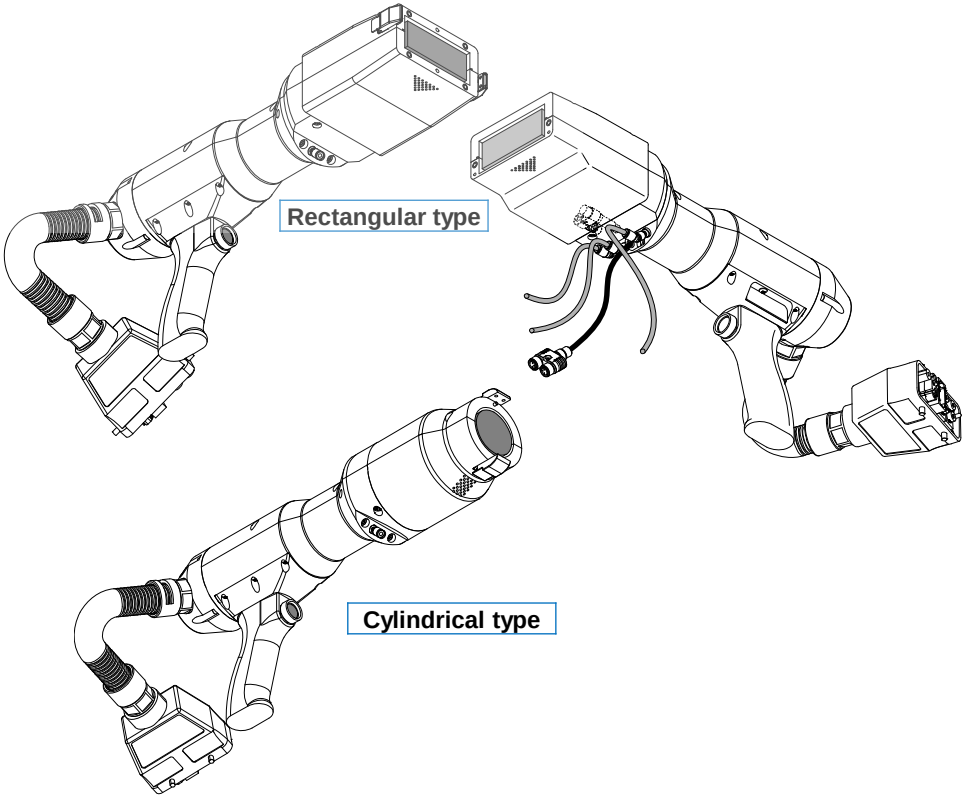
Peening programs set up

Peening cycle management (start/stop)

Parameters storage

Real time visualization of the parameters: power, frequency, vibration amplitude…

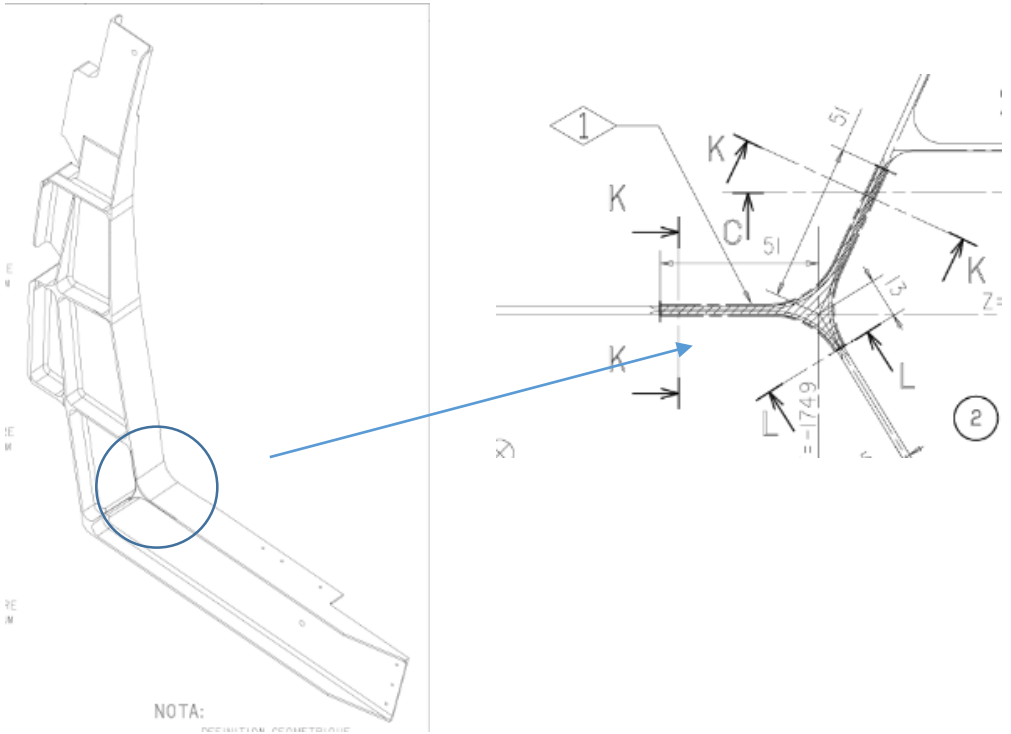
Example of peening head



Ultrasonic Shot Peening

Example with portative equipment

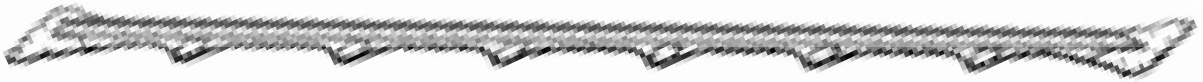
Ultrasonic Shot Peening treatment for **Structural parts**



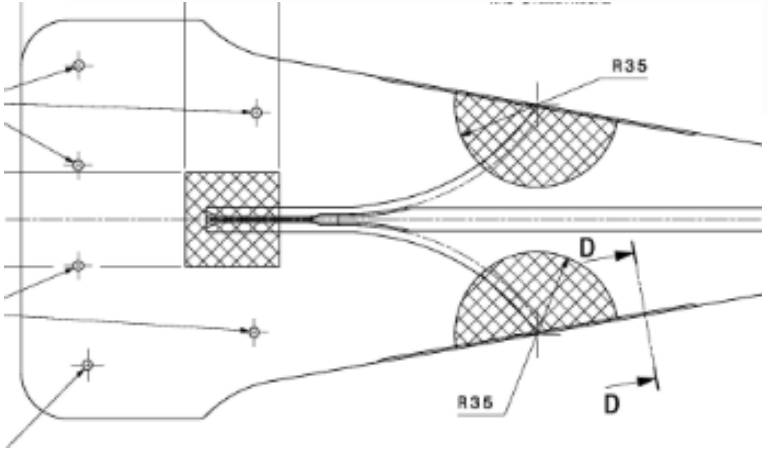
Ultrasonic Shot Peening

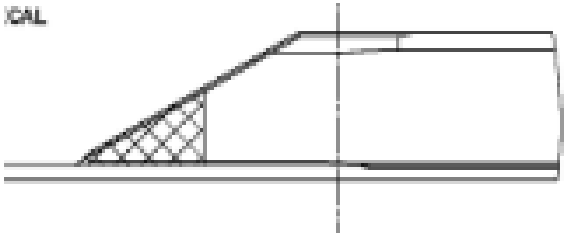
Example with portative equipment

Ultrasonic Shot Peening treatment for **Structural parts**



Length of the part : 3.7m





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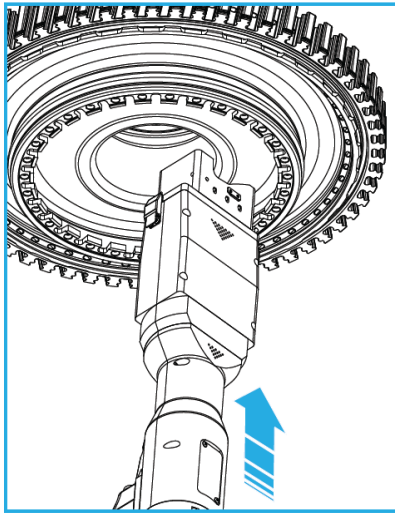
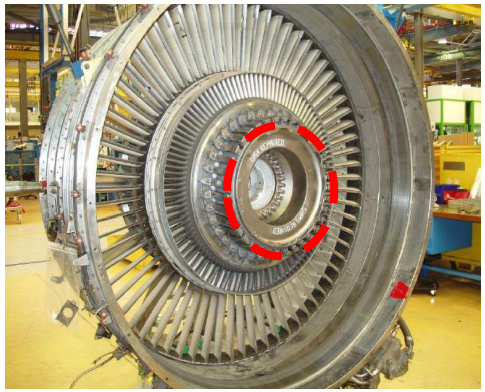
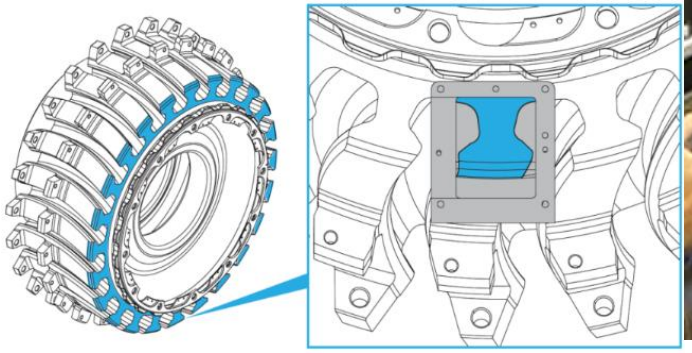
Ultrasonic Shot Peening

Example with portative equipment







Ultrasonic Shot Peening treatment for **Various Aircraft** applications

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Ultrasonic Shot Peening

Example with portative equipment

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Ultrasonic Shot Peening

Example with portative equipment

ISSUE

Early cracking in a area difficult to access on a disk (mechanical fatigue) High cost for replacement

SOLUTION

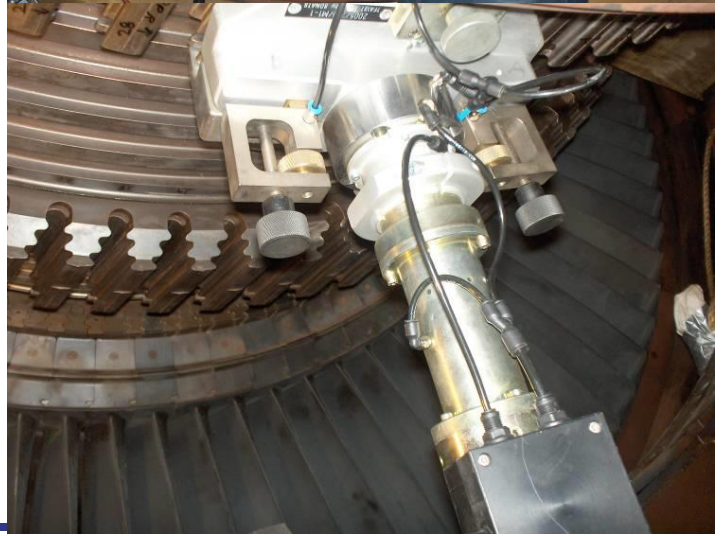
Developement of a patented process in close cooperation with the client for localized treatment. Prevent from cyclical fatigue and improve fatigue life cycle.

SERVICE

Repair on site (MRO) , Worldwide (Operator into the turbine and few dissamssebly)

BENEFITS

High ROI for the client. Repair of a damage turbine could cost 5MSD and stop production during months



Ultrasonic Shot Peening

Example with portative equipment

Commercial Aircraft

Specific enclosure

Peening Area

Hand Held Peening in Operation

Ultrasonic Shot Peening

Example with portative equipment

US Peening on aircraft

Specific Enclosure

US Peened area

Ultrasonic Shot Peening

Example with portative equipment

UH60 Black Hawk

Repair of titanium blades

Hand Held Peening in Operation

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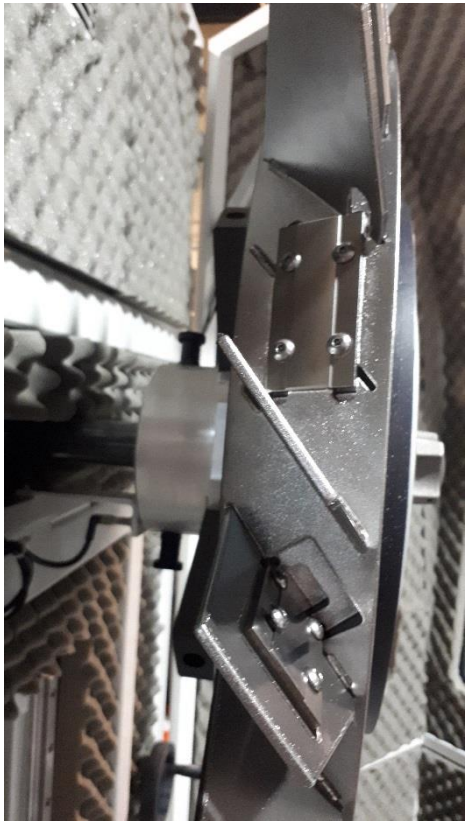
Ultrasonic Shot Peening

Example

[Shot Peening on Blisks]



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Ultrasonic Shot Peening

Example

Shot Peening on Blisks

Shot Peening on Blisks

Robotic Ultrasonic Shot Peening

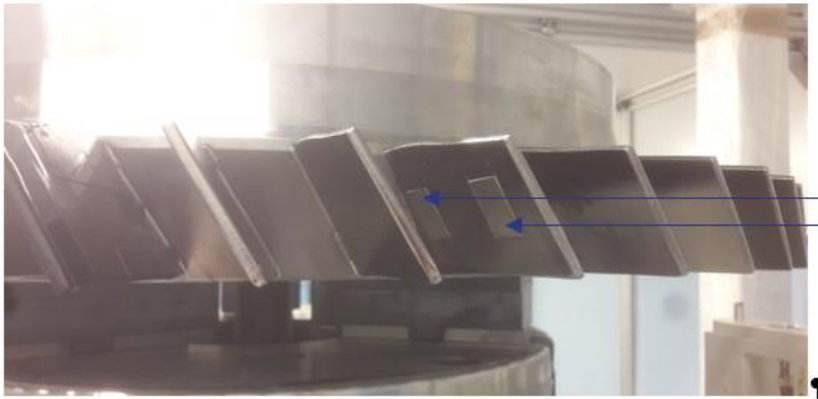
Aeronautic blisk

Ultrasonic Shot Peening
Example

Treatment on blisk – Titanium
Intensity = 0,22mmN

In·order·to·measure·residual·stresses·imparted·in·the·blisk,·SONATS·treated·2·titanium·samples·bonded·in·the·dummy·(as·presented·in·the·picture·below).¶

¶



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Ultrasonic Shot Peening
Example

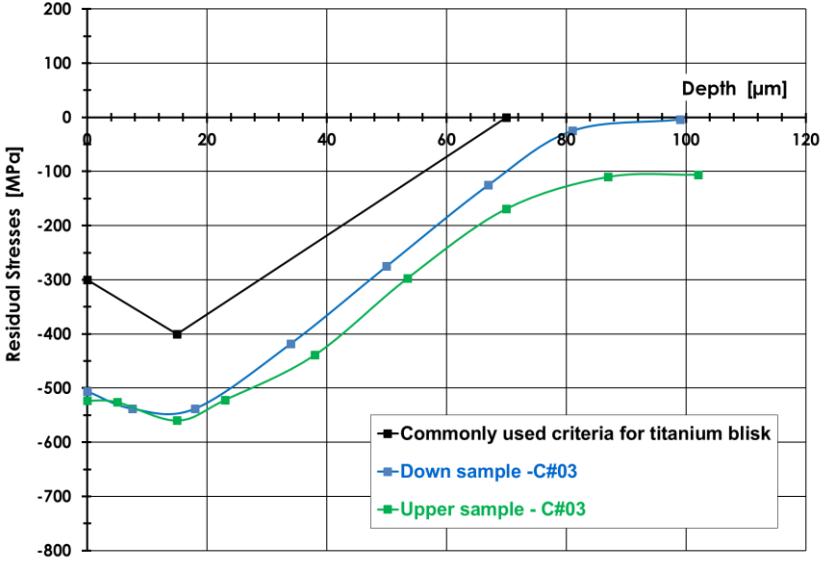
Roughness measurements on samples

DOWN						
Mesure	Longitudinal Direction			Transversal Direction		
	Ra [µm]	Rt [µm]	Rz [µm]	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,23	3,73	2,20	0,51	4,93	3,82
#02	0,32	4,17	2,84	0,45	4,92	3,68
#03	0,27	3,88	2,47	0,40	5,04	3,47
Moyenne	**0,27**	**3,93**	**2,50**	**0,45**	**4,96**	**3,66**

UP						
Mesure	Longitudinal Direction			Transversal Direction		
	Ra [µm]	Rt [µm]	Rz [µm]	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,37	4,60	3,28	0,46	6,21	4,02
#02	0,31	4,76	2,54	0,45	4,23	3,36
#03	0,35	4,71	2,93	0,45	5,17	3,73
Moyenne	**0,34**	**4,69**	**2,92**	**0,45**	**5,20**	**3,70**

Ultrasonic Shot Peening
Example

X-Ray diffraction measurements on samples



Homogenous compressive residual stresses at the surface of the blades.

For the down and upper samples the residual stresses at the surface is around -500MPa.

Maximum of compression is -550Mpa at 15 µm under the surface.

Affected depth by the compression is around 80µm.

Ultrasonic Shot Peening
Example

Roughness measurements on blisk

Before shot peening

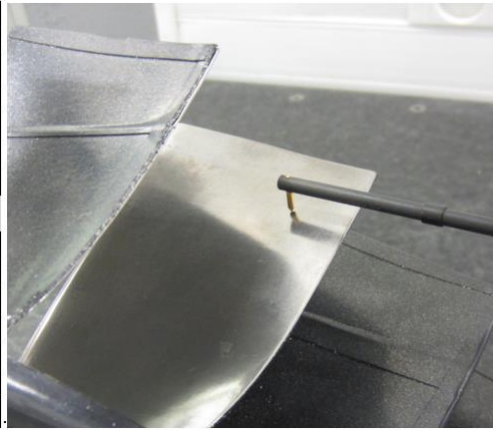
Measure	SIDE A Trans. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,15	1,25	1,12
#02	0,21	5,14	2,56
#03	0,17	3,23	2,11
Average	**0,18**	**3,21**	**1,93**

Measure	SIDE A Long. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,18	3,32	1,69
#02	0,16	2,28	1,33
#03	0,20	3,68	2,37
Average	**0,18**	**3,09**	**1,80**

After shot peening

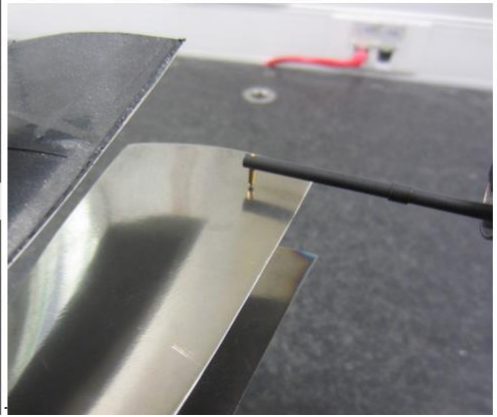
Measure	SIDE A Trans. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,20	1,63	1,35
#02	0,18	1,99	1,67
#03	0,20	1,98	1,49
Average	**0,19**	**1,87**	**1,50**

Measure	SIDE A Long. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,18	2,42	1,46
#02	0,17	1,75	1,25
#03	0,21	2,03	1,54
Average	**0,19**	**2,07**	**1,42**



Measure	SIDE B Trans. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,15	2,75	1,69
#02	0,18	2,90	1,94
#03	0,20	2,24	1,91
Average	**0,18**	**2,63**	**1,85**

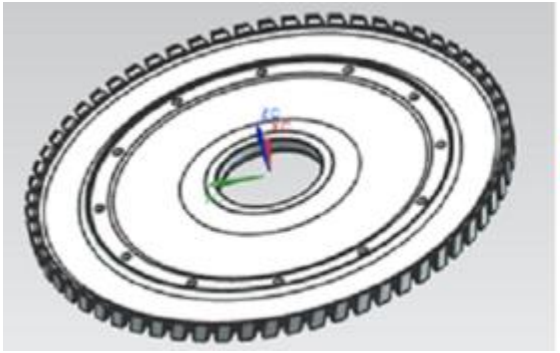
Measure	SIDE B Long. Direction		
	Ra [µm]	Rt [µm]	Rz [µm]
#01	0,20	1,77	1,42
#02	0,16	1,86	1,34
#03	0,16	1,98	1,55
Average	**0,17**	**1,87**	**1,44**



Ultrasonic Shot Peening

Example

Shot Peening on Disk



Disk (Dia ϕ 700mm, height 200-300mm)

Ultrasonic Shot Peening

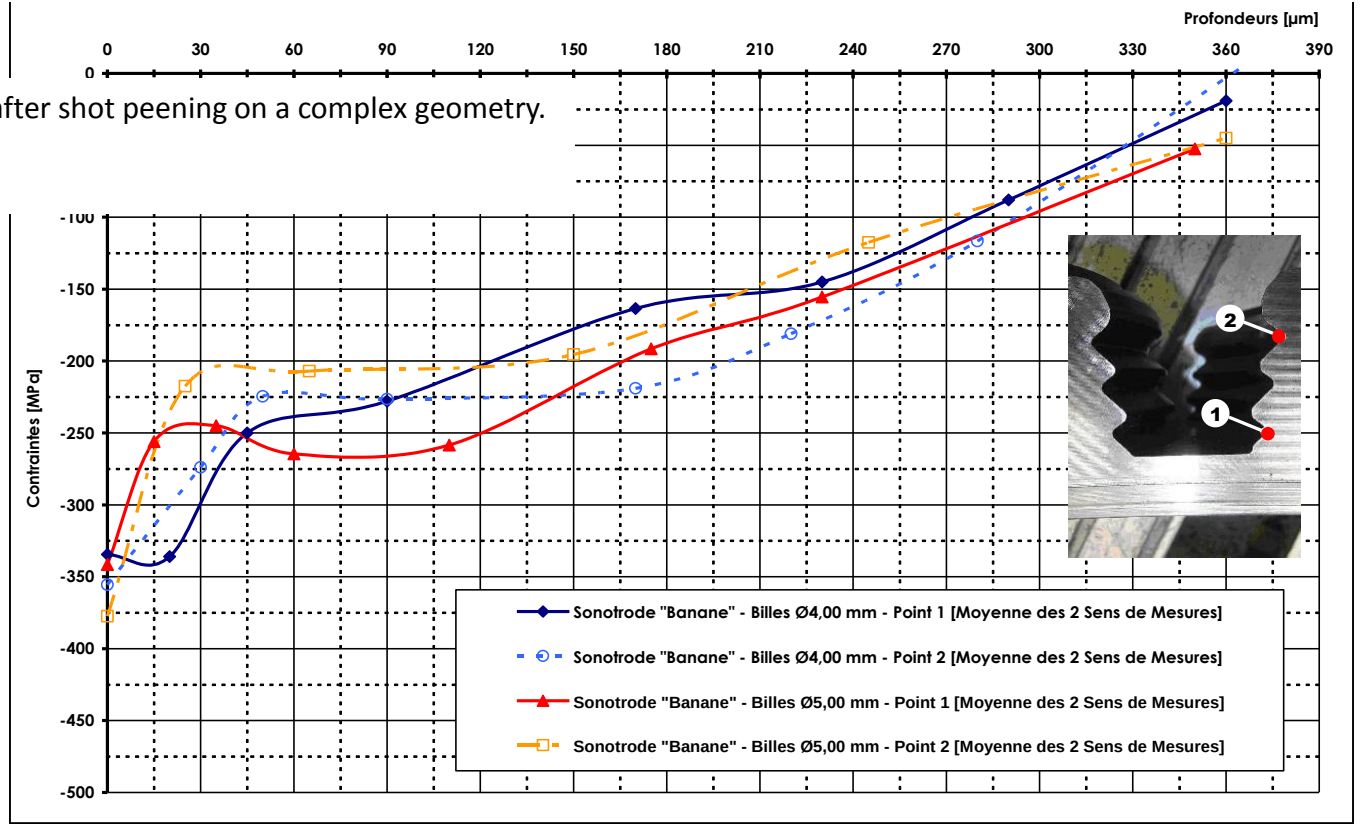
Example

Shot Peening on Disk: Shot Peening will be done with part in horizontal position

Ultrasonic Shot Peening

Example

Residual stress measurement after shot peening on a complex geometry.
(material : steel)



Ultrasonic Shot Peening

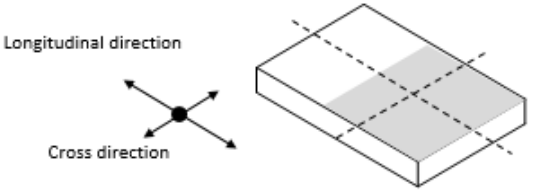
Example

Shot Peening on Blade Roots: Fully robotized machine

Ultrasonic Shot Peening

Example

Measurement Device : TAYLOR HOBSON - INTRA 2
Serial Number : 312 System n° FTSI-320
Measurement parameters : λc = 0,80 mm & Lt = 5,00 mm



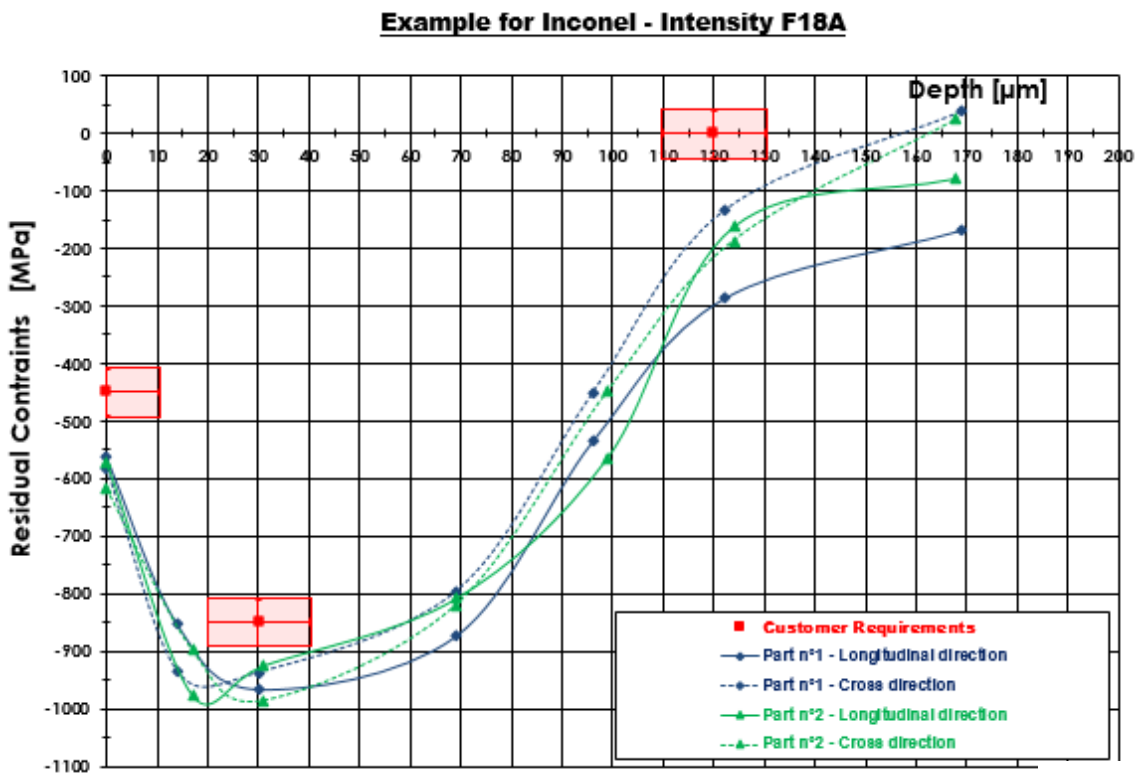
Measurement after USP on Inconel - Intensity F18A - Part n°1						
Position	Longitudinal direction			Cross direction		
	Ra (µm)	Rt (µm)	Rz (µm)	Ra (µm)	Rt (µm)	Rz (µm)
#01	0,81	6,10	4,66	0,71	6,05	4,13
#02	0,90	6,77	5,69	0,73	5,93	4,99
#03	0,88	6,51	5,25	0,72	7,48	5,38
Average	**0,86**	**6,46**	**5,20**	**0,72**	**6,49**	**4,83**

Measurement after USP on Inconel - Intensity F18A - Part n°2						
Position	Longitudinal direction			Cross direction		
	Ra (µm)	Rt (µm)	Rz (µm)	Ra (µm)	Rt (µm)	Rz (µm)
#01	(Ctrl)	4,44	3,83	0,98	6,70	5,61
#02	0,64	5,51	4,19	0,86	5,96	4,69
#03	0,60	4,75	3,62	0,63	5,02	4,00
Average	**0,66**	**4,90**	**3,88**	**0,82**	**5,89**	**4,77**

Inconel – Intensity F18A

Ultrasonic Shot Peening

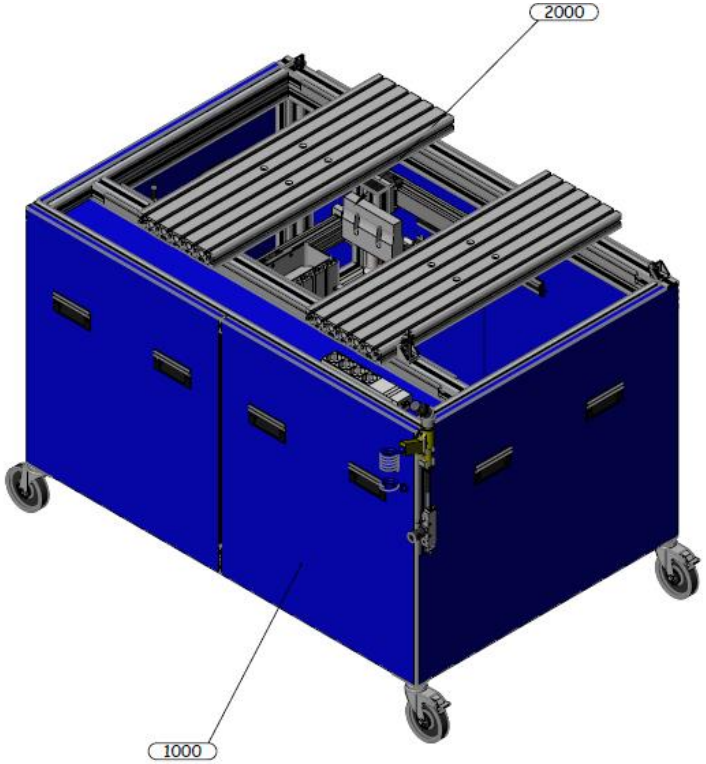
Example



Inconel – Intensity F18A

Ultrasonic Shot Peening
Example

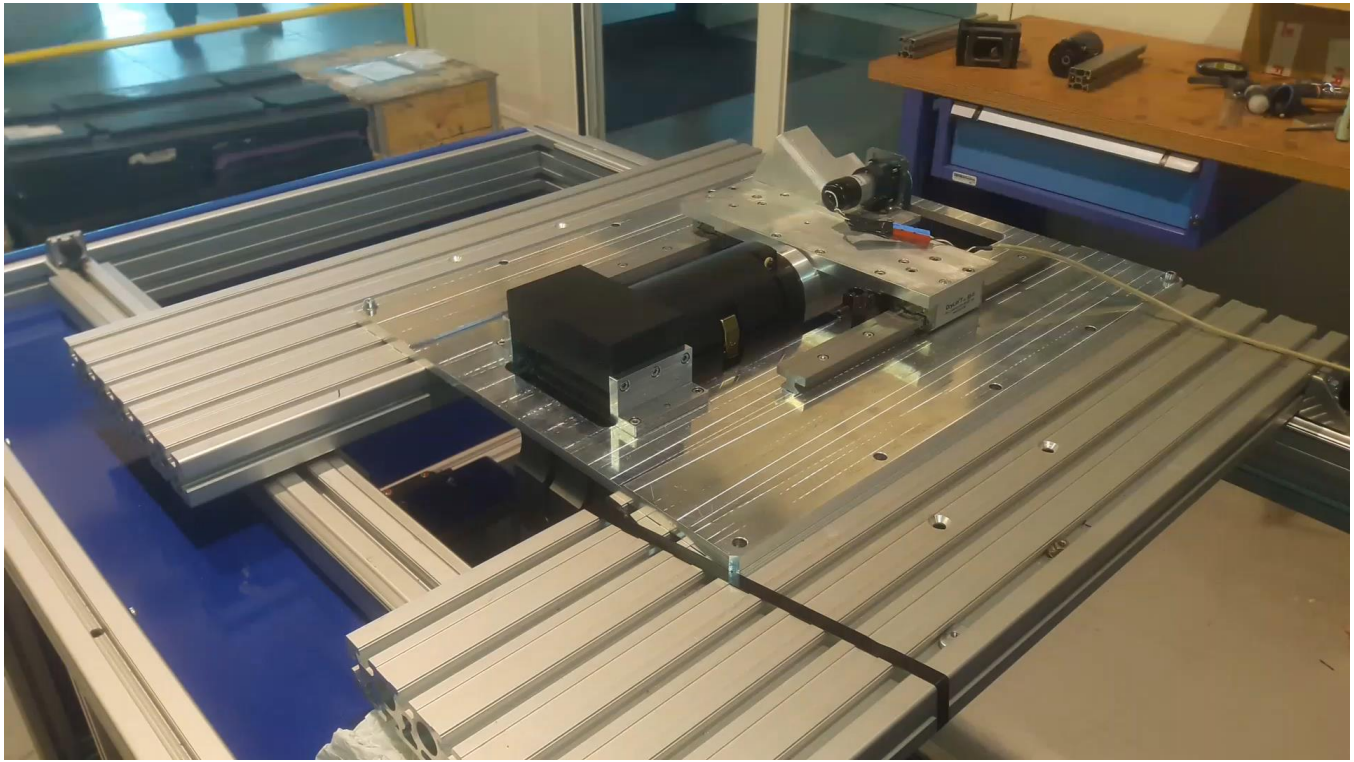
Bench for trials or small serial production



Bench and its acoustic element with a StressVoyager USP.

This bench permit to make some trials (required specific toolings), or small serial production.

Dynamic blade treatment on bench



Ultrasonic Shot Peening

Technical and Industrial Advantages

Process advantages

- Treatment precision, control & repeatability
- Treatment homogeneity
- High quality surface finish
- Tribological performance improvement –higher surface quality reduces friction and wear between moving components

→ ***Reduction in fuel consumption and CO_2 emissions.***

Industrial advantages

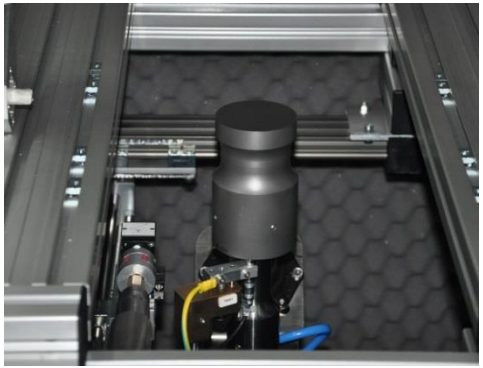
- Low media & Energy consumption
- Simple implementation (no need for masking, decontamination…) and portability of the StressVoyager/Nomad equipment
- Space saving in customer's workshop
- Clean, Low noise & Environment friendly
- Reduced ATEX/Dust Explosion risk

Safe & Green *Lean Manufacturing* solution

Ultrasonic Shot Peening
Limit

Dimentional limits

Peenable surface at **t** time is limited by the sonotrode surface

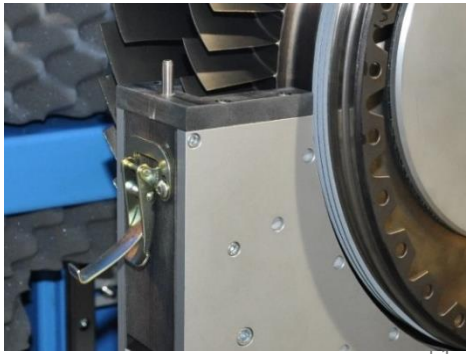


Treatment time

In some treatment configurations, a lower energy given and a lower media quantity can generate a longer treatment time for a same intensity. Shorter global cycle still enables most of the time to reach a shorter operation time

Chamber design

For each application, we design a specific chamber guarantying the treatment sealing (not loosing any beads) and the needed distance between the sonotrode and the part (reach the targeted intensity)



The ultrasonically activated shot peening is **a method** …

Simple
and easy to implement, qualitative and perfectly controlled

Reknown
and used by the OEMs in aeronautical, automotive, energy and others sectors…

Applicable
to a wide range of parts thanks to automotized and robotized industrial equipment

Safe & Green
Having a low impact on global environment: low footprint, low consumption, reduction of prior and post-operations.

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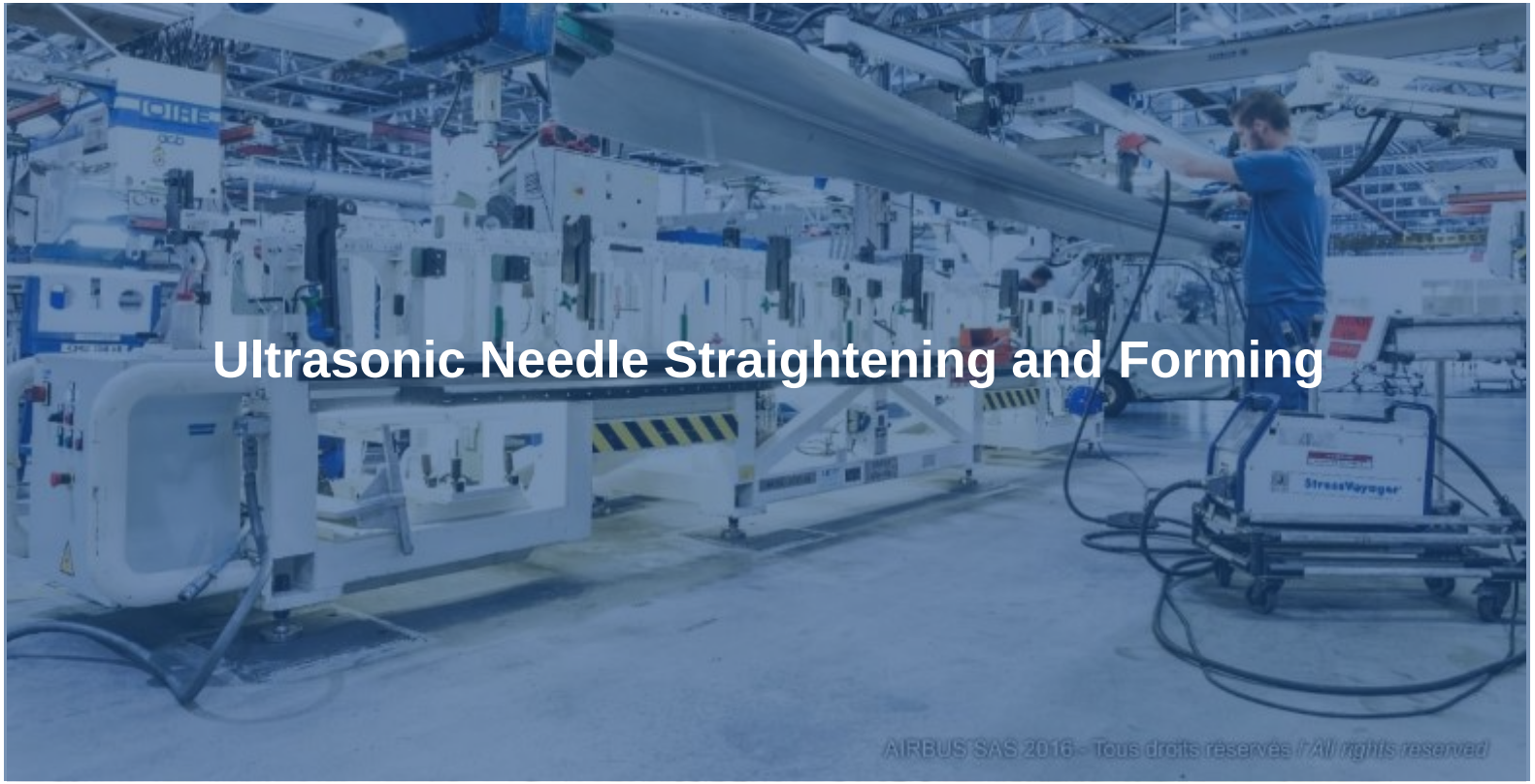


Ultrasonic Needle Straightening and Forming

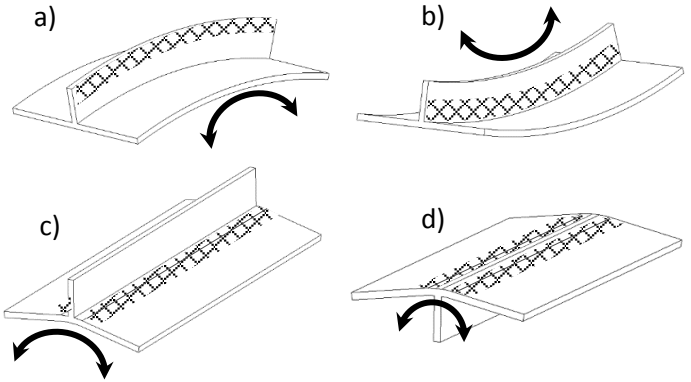
NEEDLE STRAIGHTENING

The ultrasonically activated needle straightening uses frequence and amplitude of a vibrating surface to project media to very high impact frequence.

Media are captive and guided inside the peening head. Their size and radius of impact allow an efficient compressive action while maintaining surface roughness.

The implementation is easy and direct. No bagging are needed. Continuous micro-drilling ensures a perfect controlled and progressive straightening.

SCHEMATIC DIAGRAM



Area to be peened to get the desired arc

Deformation obtained depend on the complexity of the part structure and its overall stiffness

Why uses needle straightening?

To form or straight a part in compliance with the drawing

PROCESS STANDARDS AND SPECIFICATIONS

→ **SAE/AMS 2588** *« Ultrasonically Activated Needle Peen Forming »*

→ **AIRBUS AIPI 03-10-001** *« Rectification of metallic materials by shot peening »*

→ **AIRBUS AIPS 03-10-001** *« Hard Metal Forming – General Requirements »*

→ **DASSAULT DGQT 4 2 0152** *« Finition des pièces en alliages d'aluminium usinées mécaniquement » (Aluminium alloy part finish mechanically machined)*

→ **DASSAULT DGQT0 8 3 0181** *« Formage activé par ultrasons » (Ultrasonically activated forming)*

Aerospace:

Airbus (France), Bamtri (China), ChengDu Aircraft (China), Dassault Aviation (France), FIGEAC AERO (France), MAP (France), MASA (Spain) MHI Aero (Japan), ShengYang Aircraft (China), TPI (United Arab Emirats), Xi'An Aircraft (China),

Ultrasonic Needle Straigthening

Equipment Presentation

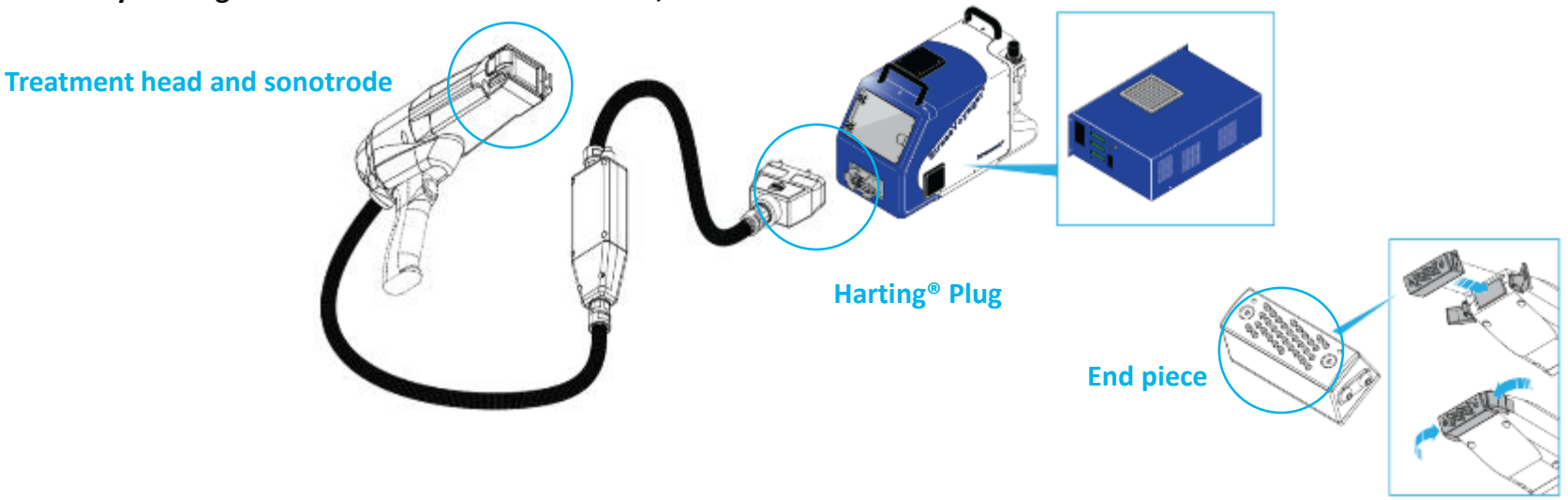
CENTRAL UNIT, EQUIPED WITH **ULTRASONIC GENERATOR**

→ Portative, compact and light equipment (Central unit about 30Kg, Peening Head from 3 to 5kg)

→ **Low energy consumption** (<300W). Compressed air , 6 Bar, 200 l/min for cooling.

→ Ergonomic handheld equipment enables an efficient and safe operation (no risk for the operator, nor for the part)

→ **Easy and ergonomic human-machine interface ,** tactile and color screen



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Ultrasonic Shot Peening

Portative equipment

Touchscreen

Peening cycle management (start/stop)

Parameters storage

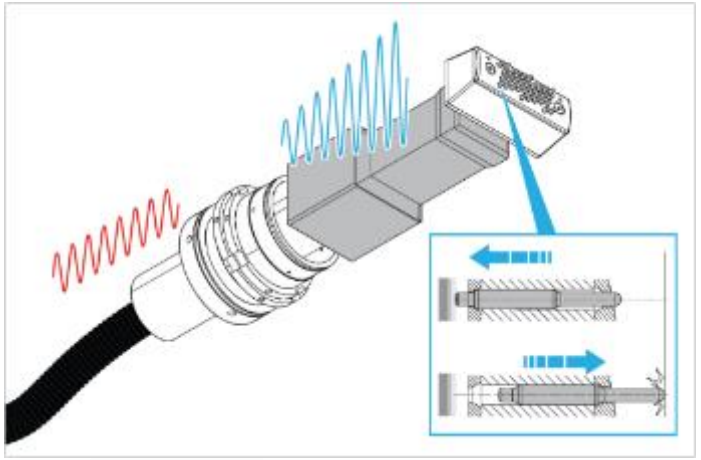
Real time visualization of the parameters: power, frequency, vibration amplitude…

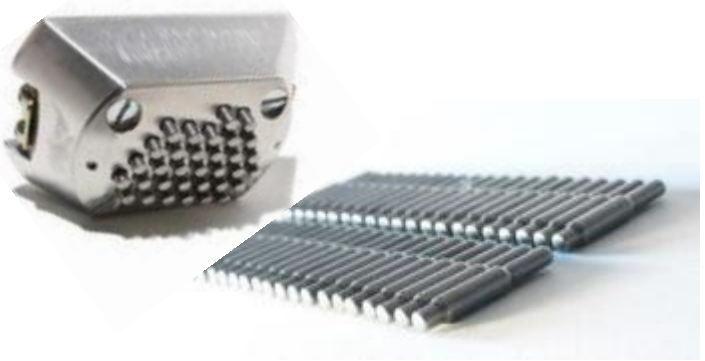
Possibility to connect different treatment heads on the same central unit.

Ultrasonic Needle Straigthening

Equipment Presentation

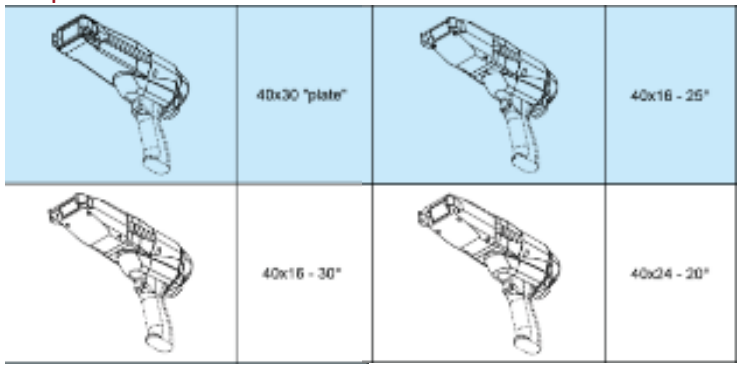
- → Treatment head vibrations are very low, impactors move back and forward **without any ultrasonic transfer to the operator nor the part**
- → Straightening operations are very brief in time
- → Noise emission related to the impact of needle is the same than manual hammer peening. Need to be taken into account and be used with ear protections

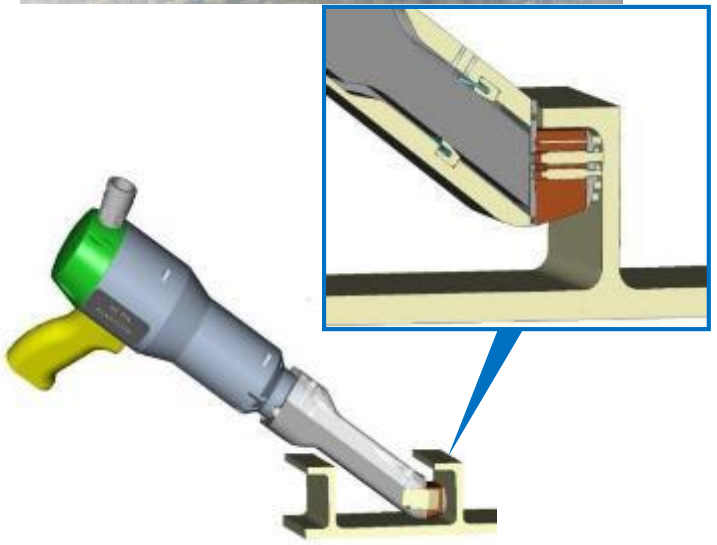




Different type of treatment head configuration

Example of customized treatment head :
following accessibility, and possibility to make specific design following customer's requirement





Interchangeable end pieces

- Varying treatment intensity by changing the size of needles
- Varying number of needles change the accessibility conditions and intensity

PR07 inclined treatment head

Diameter 2mm

Diameter 3mm

PR01 straight treatment head

Diameter 2mm

Diameter 3mm

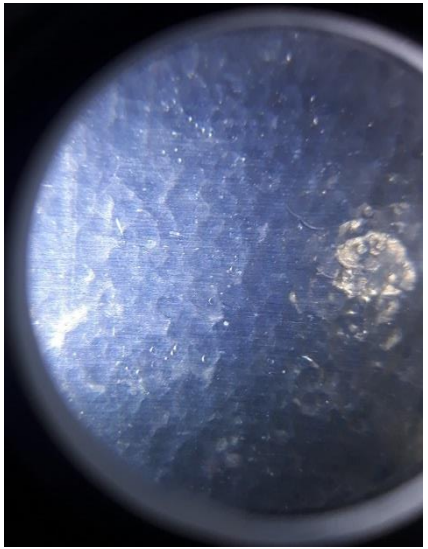
Diameter 4mm

Surface aspect after treatment

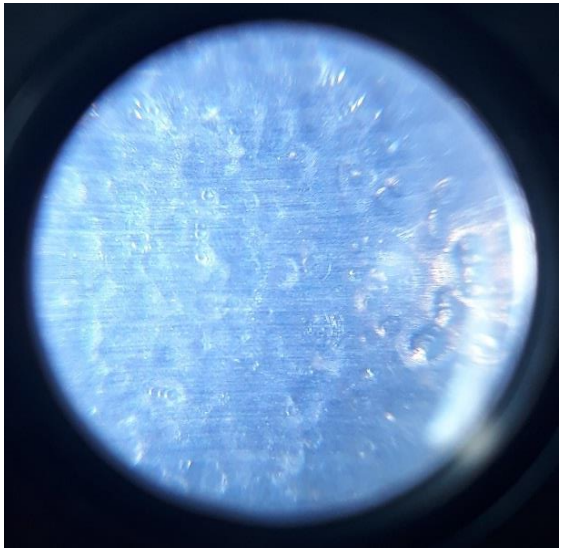
Machining | Conventional | Ultrasonic

Surface aspect after treatment

PR01 – Impactor diameter 2mm



PR01 – Impactor diameter 4mm

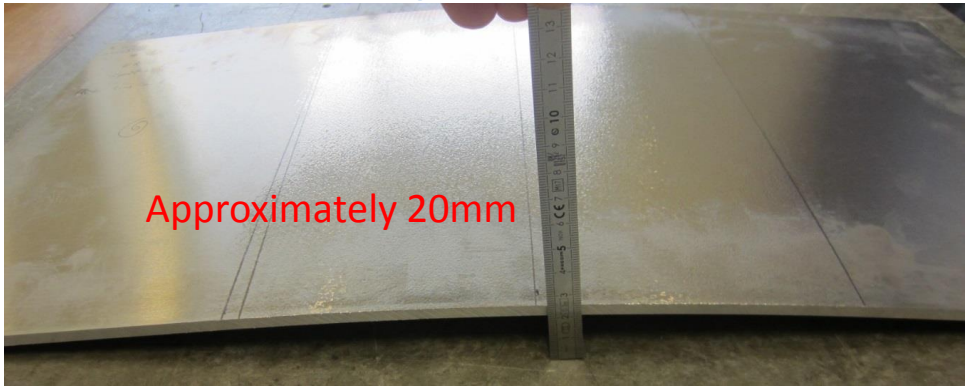


Tests of deformations

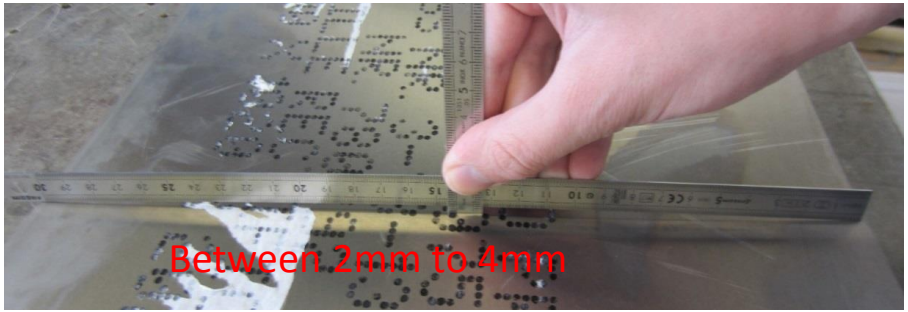
Aluminium 7075 T651
Size 609,6x304,8x6,38mm

Tests done with PR01 & PR17

Arc measurement parallel to the fiber



Arc measurement perpendicular to the fiber

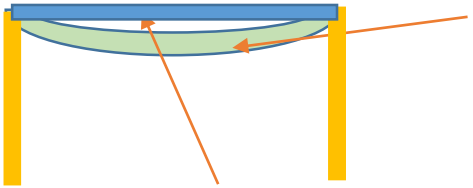


Ultrasonic Needle Straigthening

Example

Aerostructure : Fitting frame after machining

After machining, some parts and specifically in around the pockets there are some deformations.



In green, the shape after machining

In blue, the final shape

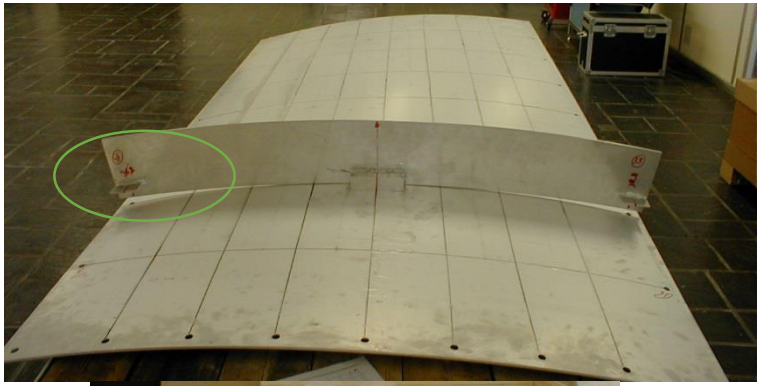
Some examples using hard materials, as Titanium alloys.

Ultrasonic Needle Straigthening

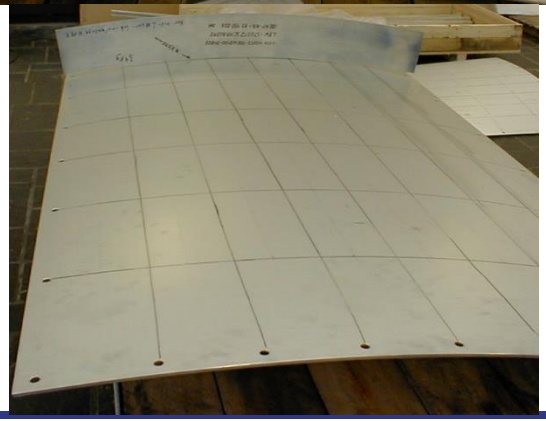
Example

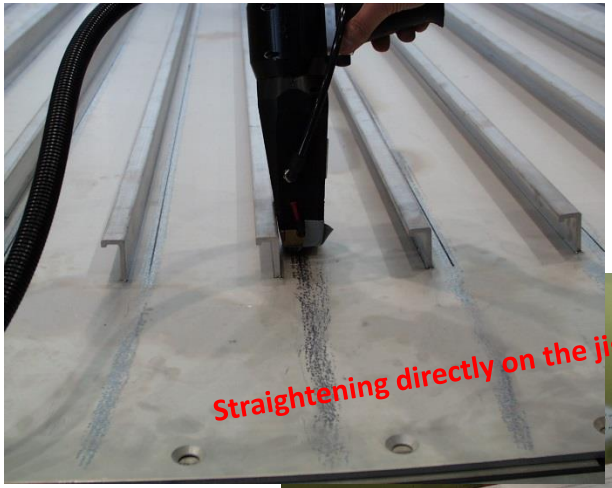
Aerostructure :Wings structure with its stiffeners

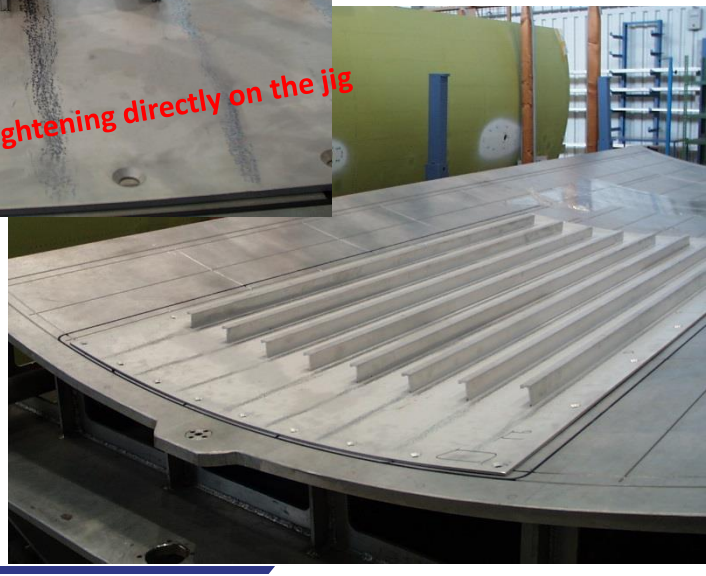
Before



After







Ultrasonic Needle Straigthening

Example

Aerostructure

Ultrasonic Needle Straigthening

Example

Aerostructure

Ultrasonic Needle Straigthening

Evolutions of the equipment

EVOLUTION IN 2016:

New generation of the generator to have a better adjustment of the parameters.

EVOLUTION OF OUR EQUIPMENT IN 2018:

A new design, and a new conception in order to optimise the vaccum of the impactors.

Better positionning of the Ventury system, and also allow the possibility to increase the lenght of the cable.

Increase of the ergonomy of the head.

Maintenance facilitated due to a new assembly of the components (seals, pipes, cables…).

We are also available to define with customers the best head, or if necessary to design a new solution in case of difficult access.

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