



# SONATS

Europe Technologies group

**EXPORTREFORM**  
Verktug & Industriugnar

## Innovative impact surface treatment solutions

*Automotive & Industrial applications*



Innovative impact surface treatment solutions



## CREATION

1991



## SUBSIDIARY

**Europe  
Technologies  
Group**



## LOCATION

Headquarters in Nantes  
(FR)

Sister Company in USA  
**EMPOWERING  
TECHNOLOGIES Inc.**  
(ETI)

Sister Company in China  
**EMPOWERING  
TECHNOLOGIES CHINA**



## EXPERTISE

**Innovative in  
Mechanical impact  
surface treatments**



## CERTIFICATIONS

SONATS Quality  
**ISO 9001 & EN 9100**



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 treatment, composite welding, cutting, sanding...)**
- **International MRO services (aircrafts, vessels, ...)**

## Key Figures 2017



**400**  
(employees)



**70 M€**  
(Turnover)



**8**  
**subsidiaries**  
(20000 m<sup>2</sup> of  
buildings)

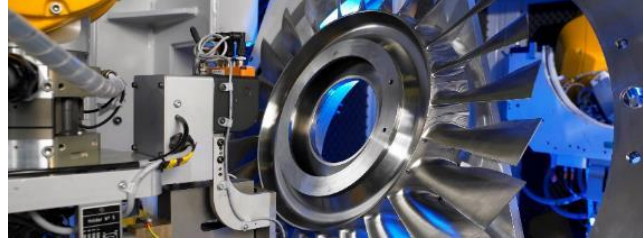


**35%**  
(Export)



**15%**  
(R&D  
investments)

**Ultrasonic Shot  
Peening**  
  
**USP**



**Forming &  
Straightening**  
  
**UNS**

**High frequency  
mechanical  
impact**  
**HFMI/UIT**





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# Our activities



## **Stress lab characterization expertise**

X-ray diffraction,  
Incremental Hole-  
Drilling

## **Process & Applications Studies**

Feasibility, Materials,  
STRESSONIC® Parameters

## **Design and Manufacturing**

Specific Tooling and  
Standard or Customized  
Machines

## **Sub-contracting**

Shot Peening in our  
Workshop in  
Nantes, France

## **On-site Treatment Operations**

In France, Europe and Worldwide  
(shot peening, impact treatment,  
flapper peening)

## **Specific Training**

Shot Peening and Flapper  
Peening

FAA-accredited Training  
material and Trainers

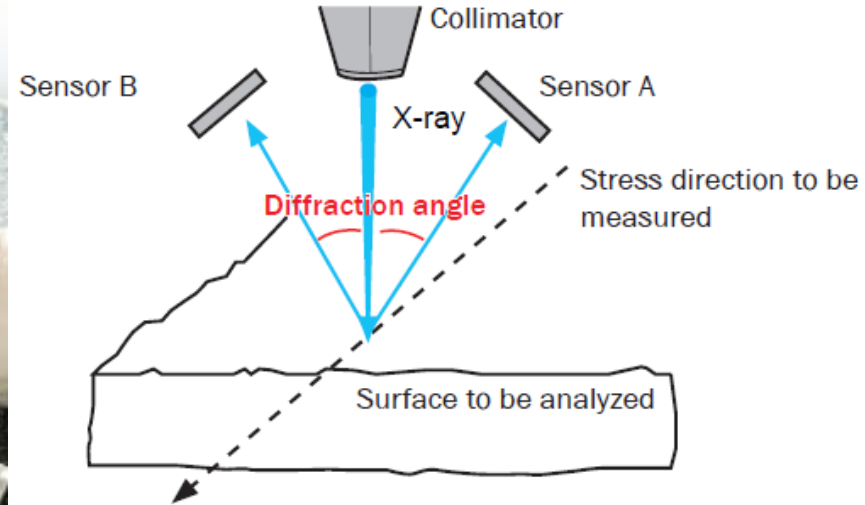
## **Distribution**

Shot Peening control **accessories  
and consumables**

Electronics Inc. (Almen,  
MagnaValves....)  
Shockform Aero.  
(FlapSpeed™, InspectView™)



**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





## 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

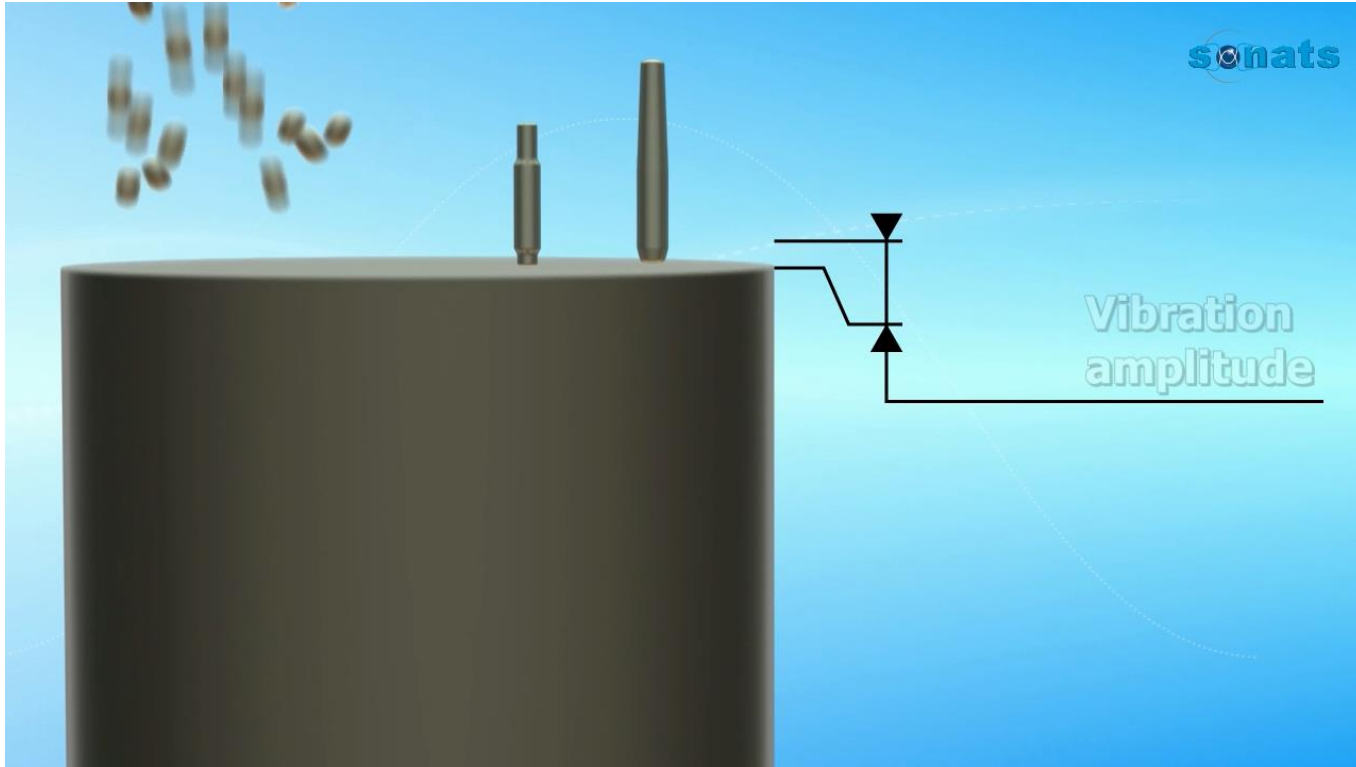




**SONATS**

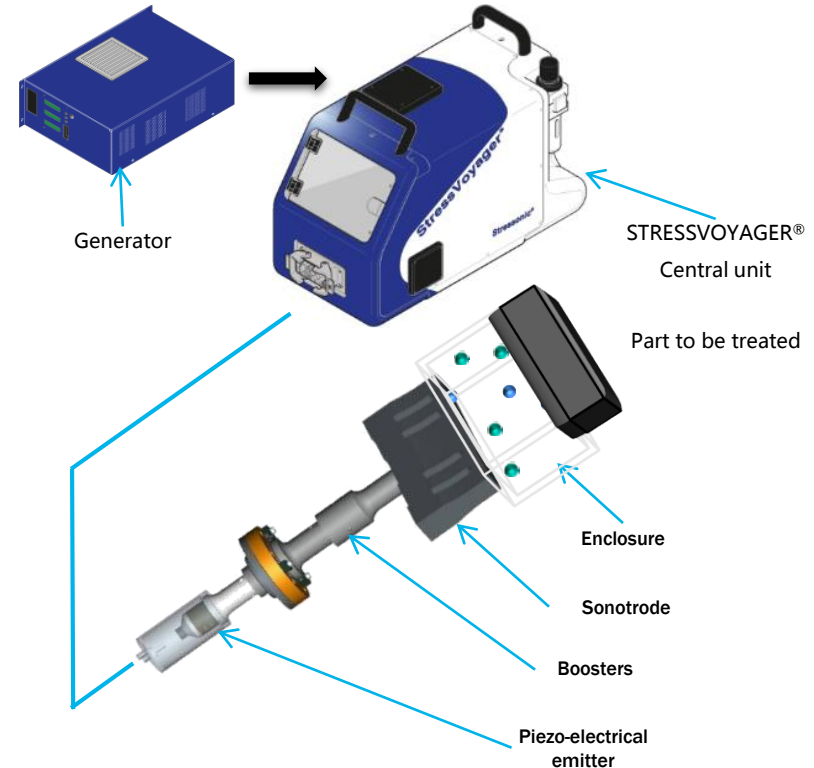
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# STRESSONIC® Technology



## Principle

- 1 The **generator** digitally generates an electrical sine wave at a high frequency of 20 kHz (ultrasonic frequency).
- 2 **Piezo-electrical emitter** converts this signal into a mechanical vibration which is then amplified by a series of boosters and the ultrasonic sonotrode.
- 3 **Media** are gaining their kinetic energy from the sonotrode vibration, and are thrown to the part to be treated inside a hermetic chamber.
- 4 **Random displacement of the media** inside the volume of the chamber and the treated part ensures a uniform peening of the part.





# Ultrasonically activated Shot Peening (USP)





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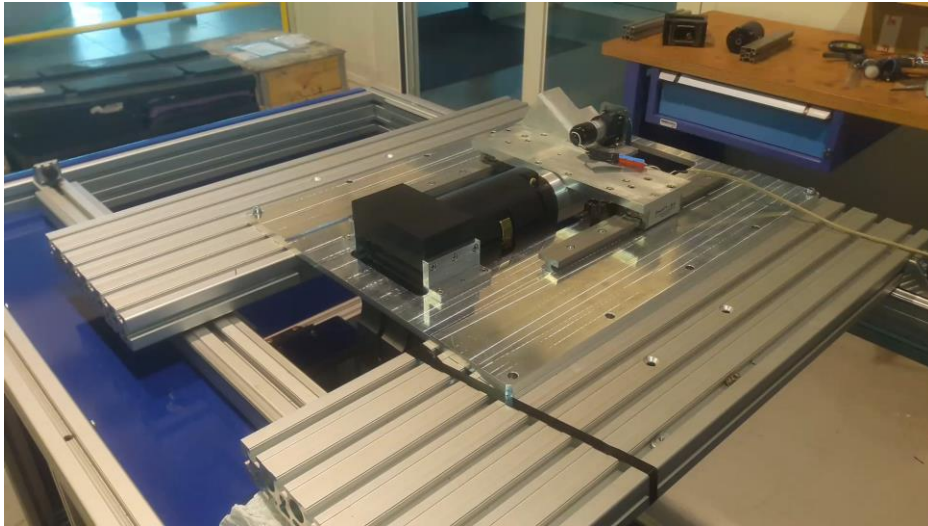
## Technical and Industrial Advantages

*Treatment Homogeneity*

Even for **Complex geometries**



## Dynamic blade treatment on test bench



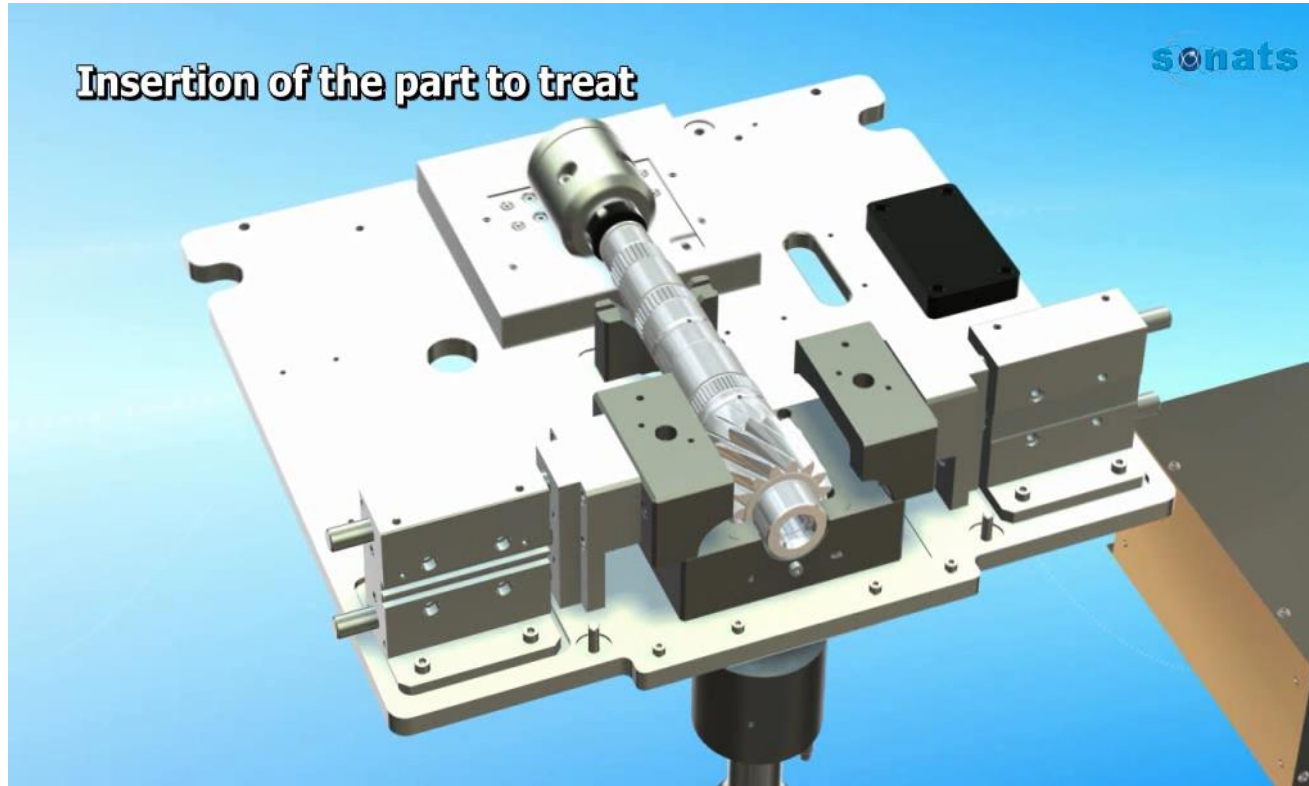


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## Industrial Exemples

*Customized machine (Automotive)*





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## Ultrasonic Shot Peening *Specifications & 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 »



**AIRPI 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, Airbus Helicopter, Bamtri, Boeing, CAC, Dassault, Latécoère, Nexter, Safran Landing Systems, Safran Helicopter Engines, Safran Aircraft Engines, MHI Aero, MTU Aeroengines, Saljut, SKF Aeroengines, Ratier-Figeac, Pratt&Whitney, Rolls-Royce, US Army, XAC

### **Automotive:**

Daimler, Erkert, Bosch, Toyota, PSA, Renault Sport Racing, L'Orange, SKF, Valeo, Continental

### **Power Generation and Heavy Industries:**

Alstom Power, GE Gas turbines, GE Energy, MTU Friedrichshafen, Hydro Quebec, MAN Diesel, KHEL, Wärtsila, Caterpillar, Toshiba Nuclear, MHI Nuclear, AREVA, Cummins, Hilti, ThyssenKrupp, Arcelor Mittal, Nexans, ABB Turbo Chargers





### Shot Peening principle

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

### Process Targets

#### Residual Compressive Stresses Introduction :

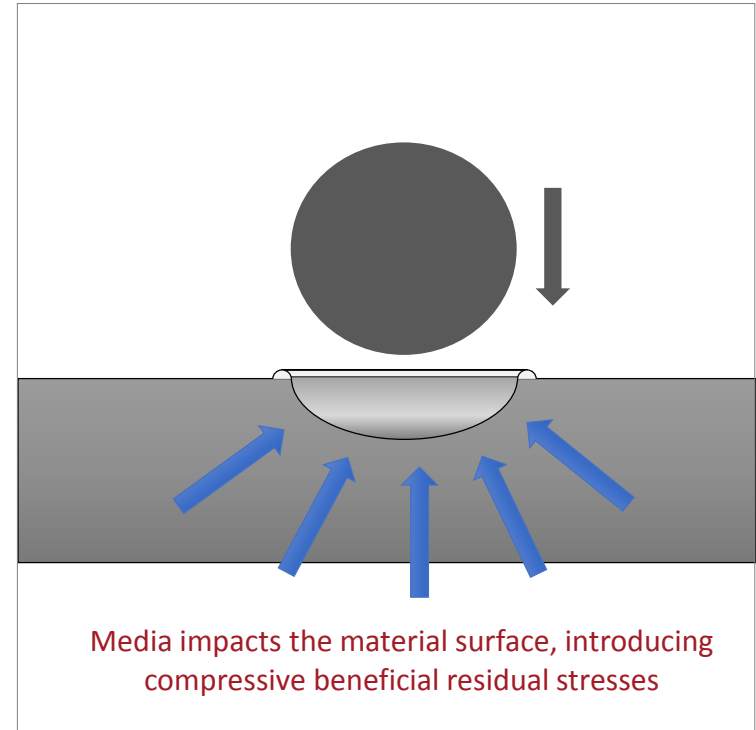
- Texturing
- Roughness Modification
- Nano-crystallization
- Compaction...





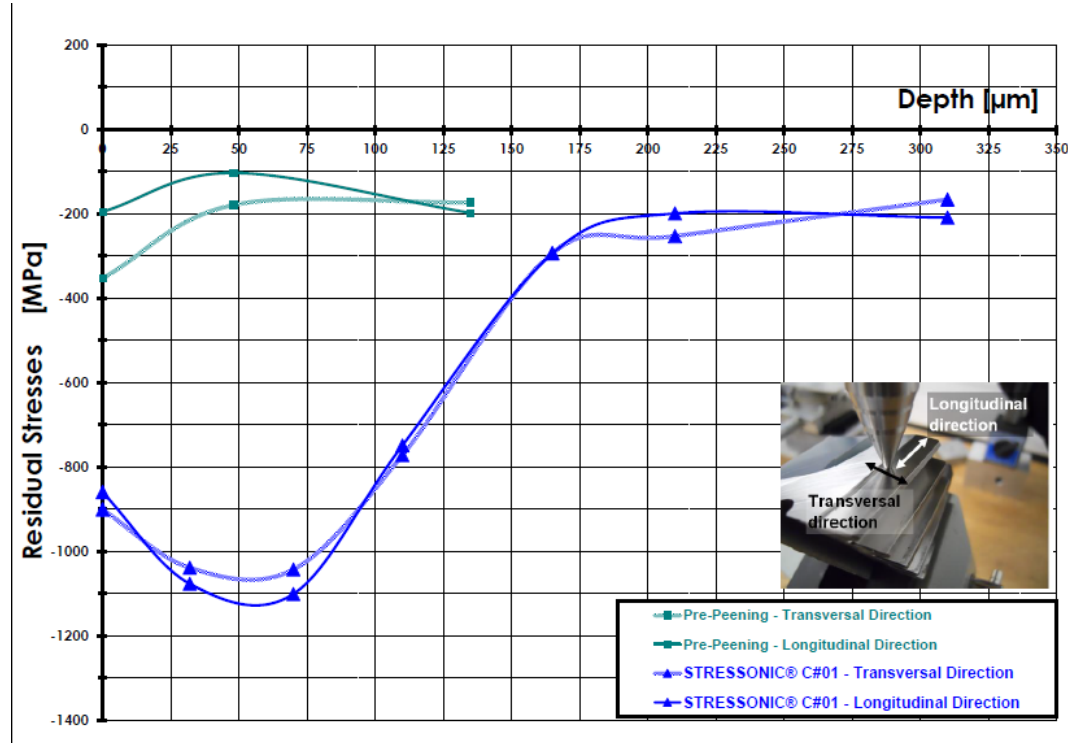
### Why using Shot Peening?

- 1 / Improves fatigue life and parts reliability
- 2 / Enhances stress corrosion cracking resistance
- 3 / Can be used on most seen metallic and ceramic materials: **Steel, Aluminum, Titanium, Inconel, Stainless Steel, Zirconium, ...**





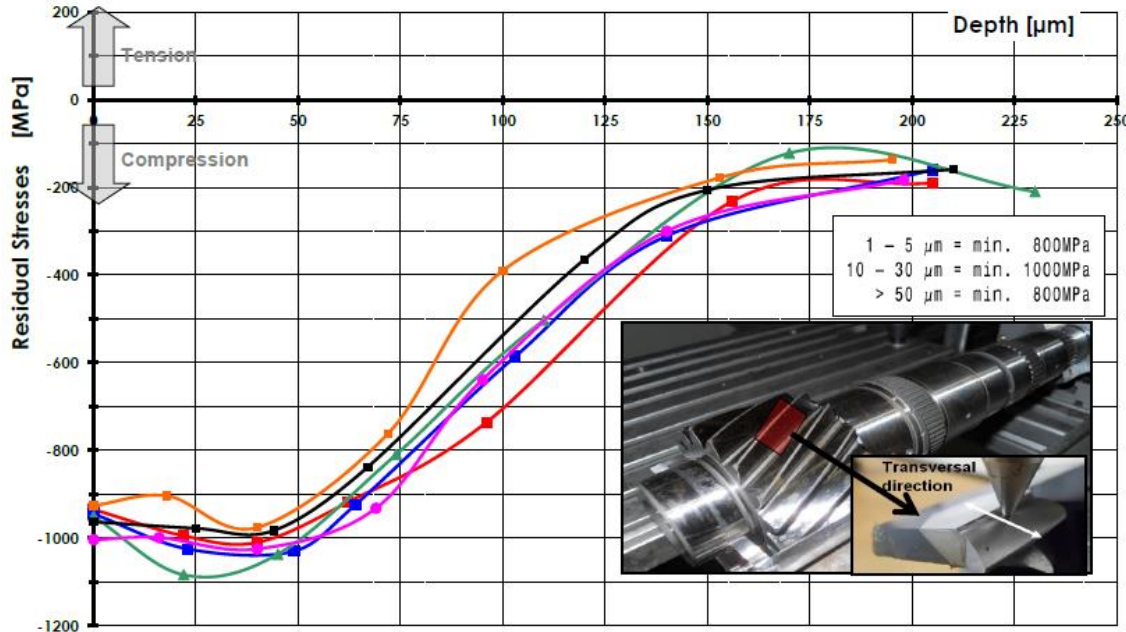
### Residual stress curve example on Gear





### Residual stress curve example on Output Shaft

Parameters	Condition #04
Media :	100C $\pm$ $\phi$ 1.0 mm - 63 $\pm$ 3 HRC
Ball set mass :	14.0g
Amplitude :	110 $\mu$ m p/v
Peening time :	90 sec
Speed rotation :	6 rotation/min
Coverage :	> 100% on root tooth



Verification of the treatment repetability  
(machine with different station or  
different version of output shaft)

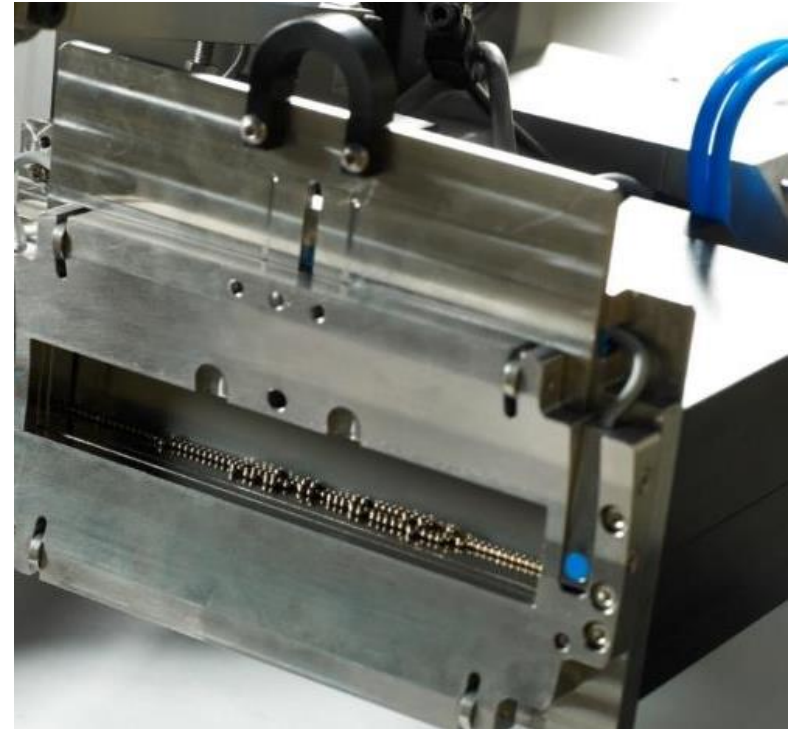


### Ultrasonic shot peening goals

Introduction of beneficial compressive residual stresses in a **controlled, reliable and repeatable** way.

### Main 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**

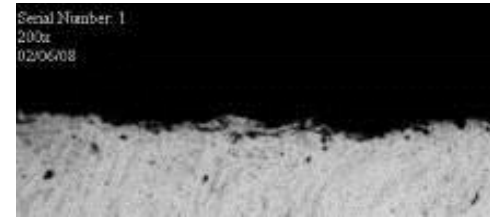




### Media or Beads

- Only **few 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)

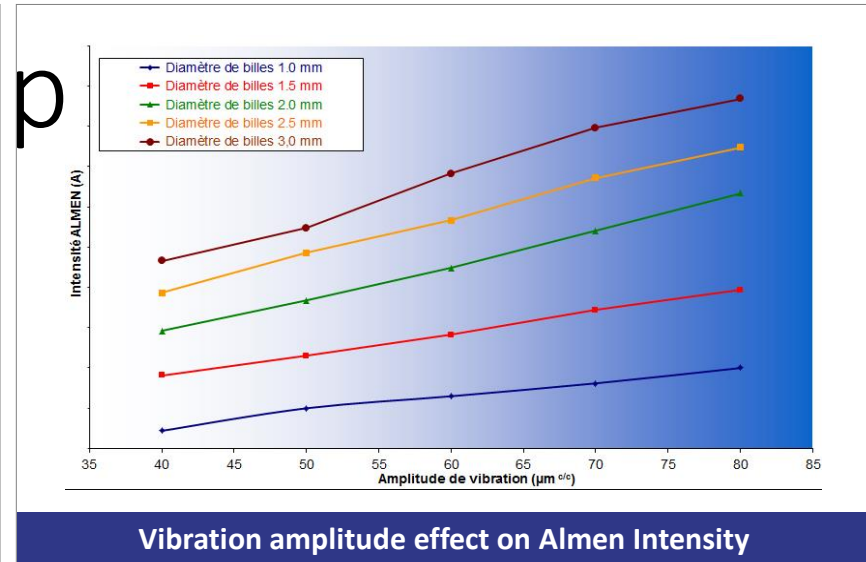
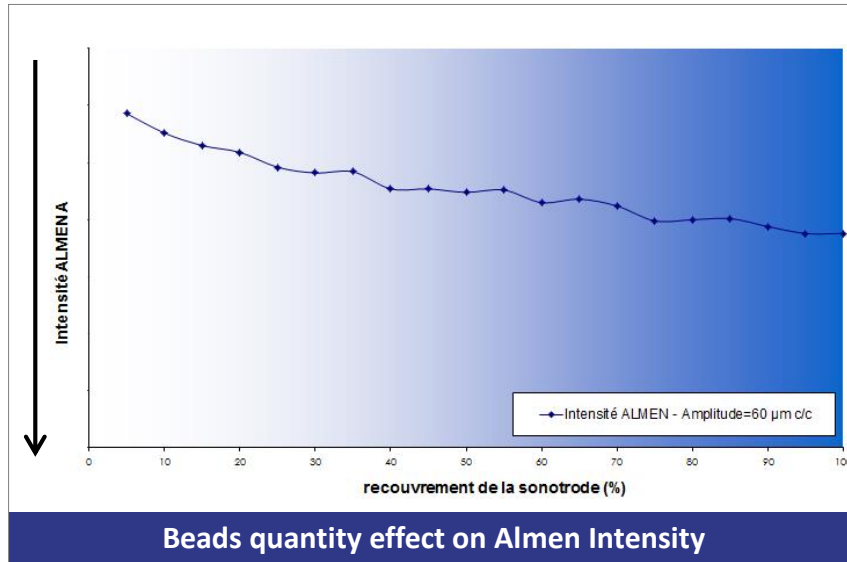


Stressonic® (USP)



### Whole range of almen intensity available

#### N-A-C Almen Intensities





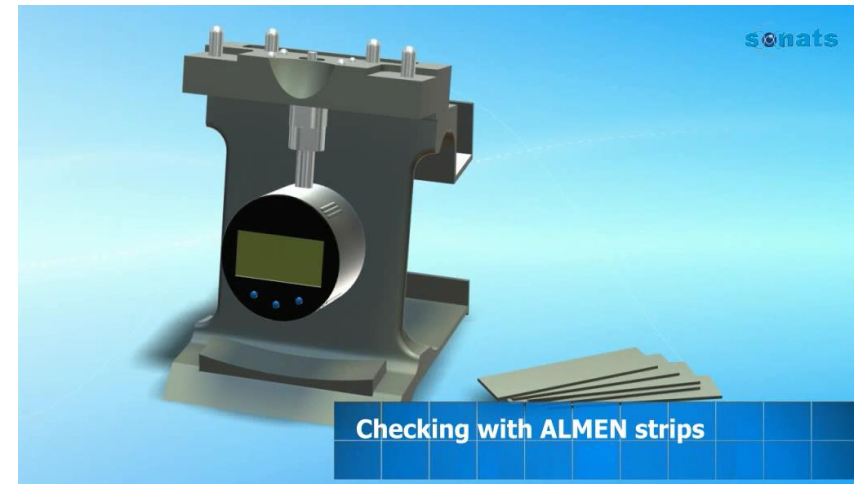
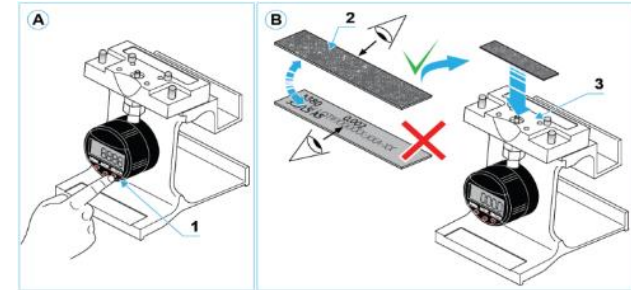


### Intensity control on almen strips

- **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

**BNAE - NF L 06-833** "Aerospace series -Ultrasonic shot peening for inducement of compressive surface stresses for metallic parts » Mai 2009

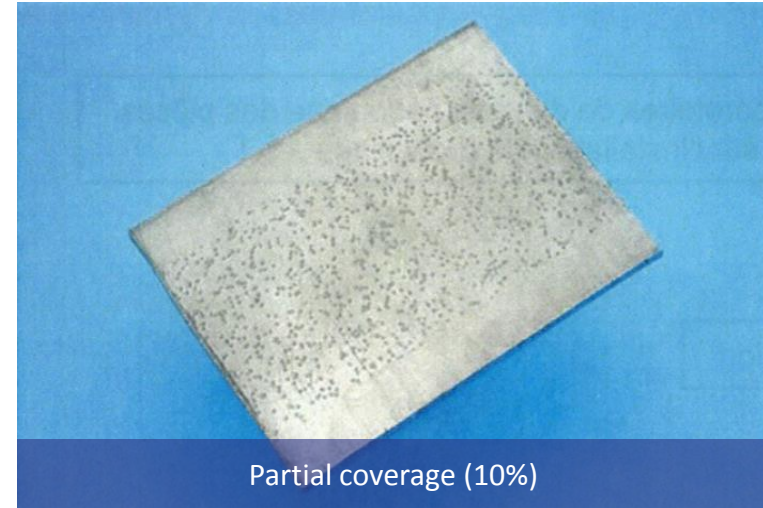
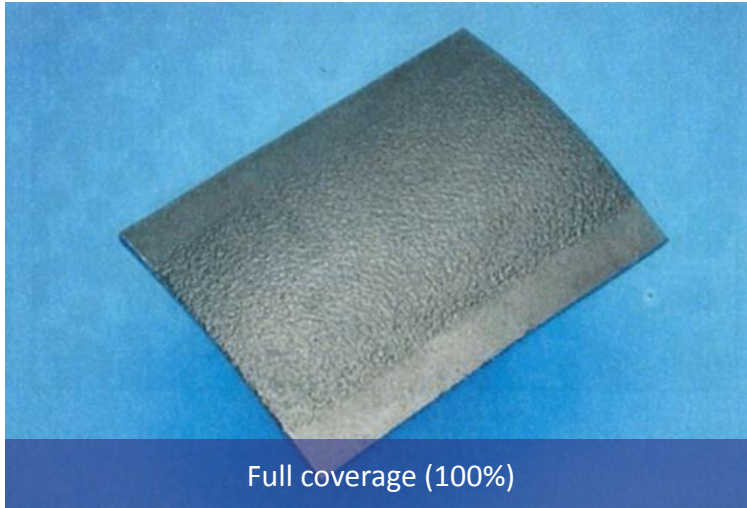
**SAE/AMS – AMS 2580-2585** "Ultrasonically activated shot peening" Mai 2010

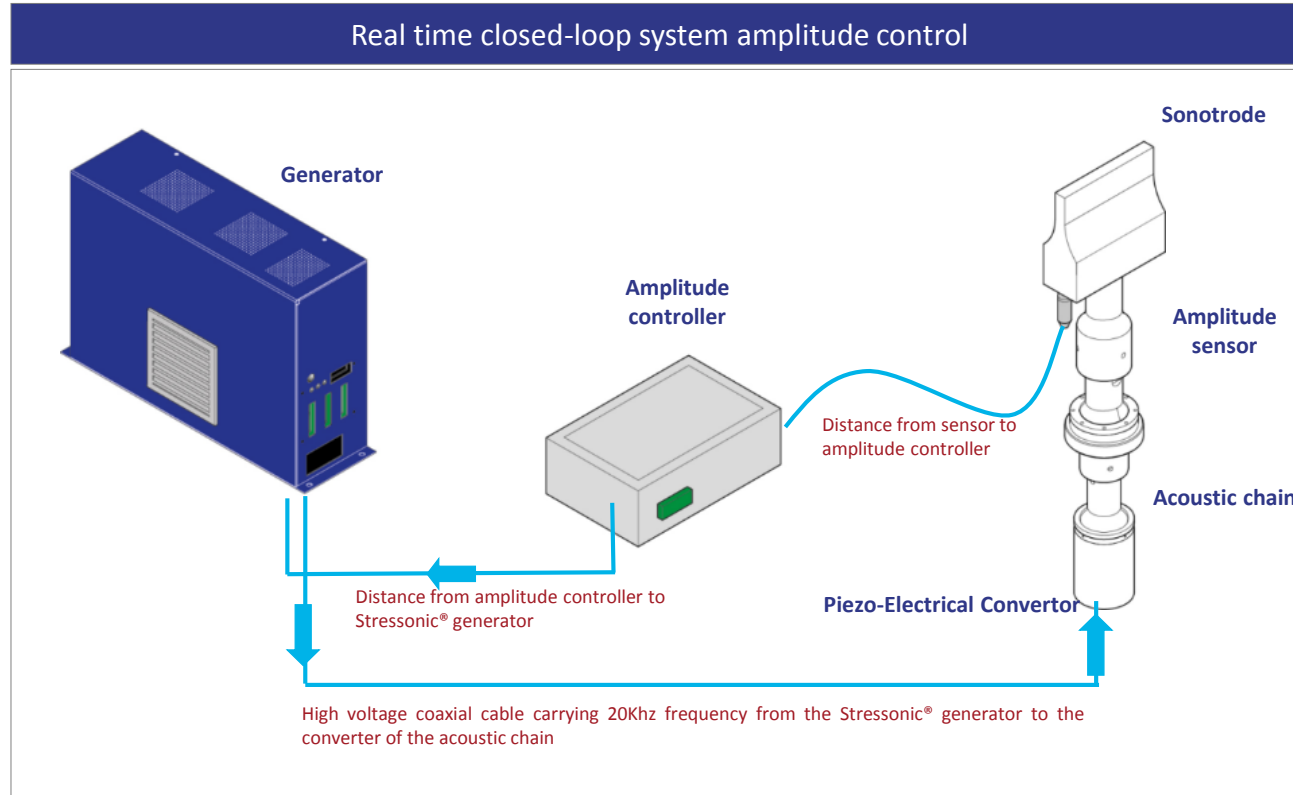




### Coverage

Number of impacts measured on an area





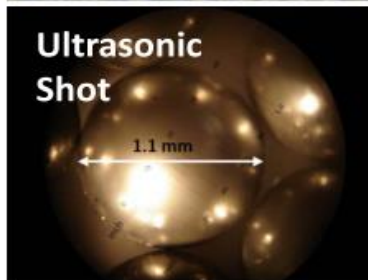
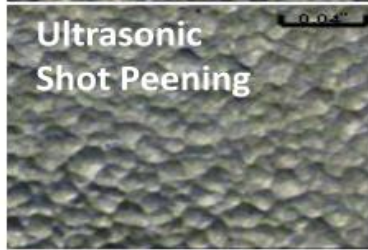


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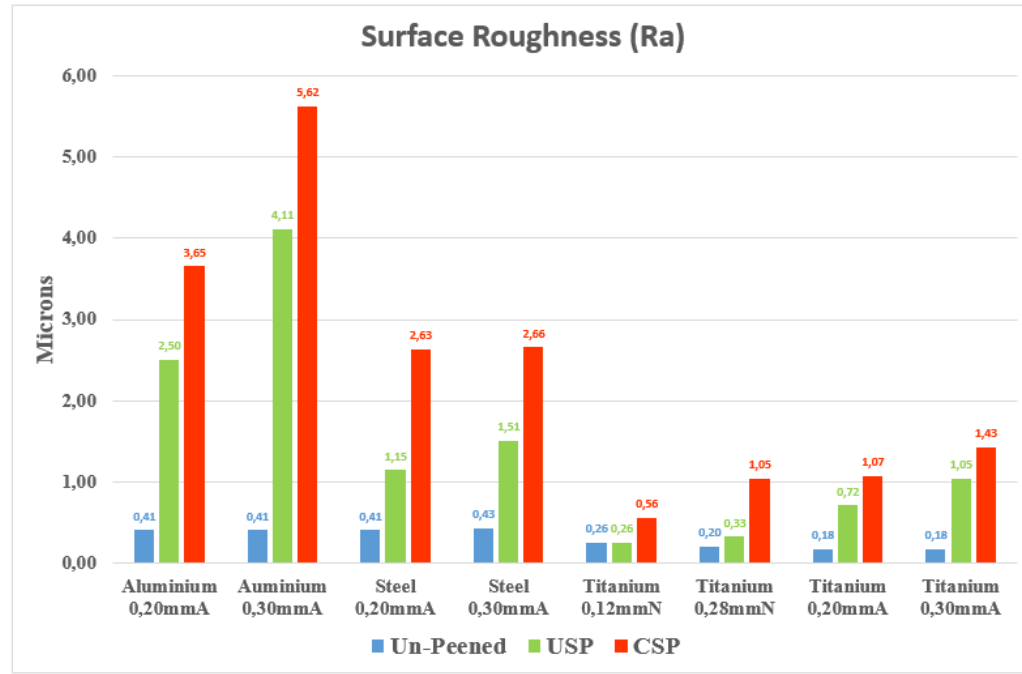
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## Ultrasonic Shot Peening

*Technical and Industrial Advantages*



### Lower ROUGHNESS after ultrasonic shot peening comparing to conventional methods





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## Ultrasonic Shot Peening Technical and Industrial Advantages

### ROUGHNESS example on Output Shaft

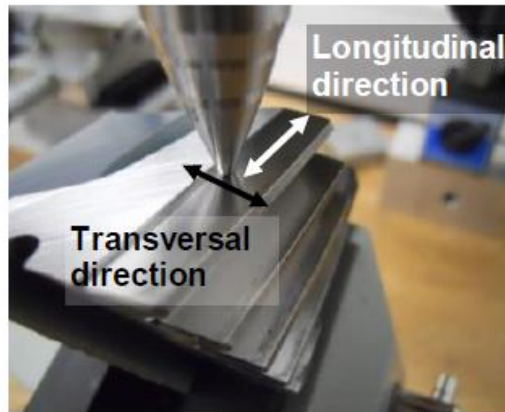
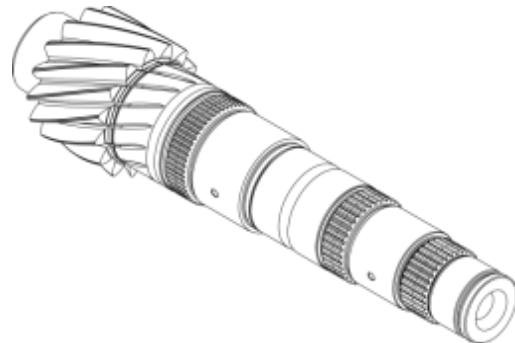
After USP

Measure	Transversal direction			Longitudinal direction		
	Ra [μm]	Rt [μm]	Rz [μm]	Ra [μm]	Rt [μm]	Rz [μm]
#01	0,48	3,64	2,82	0,44	2,64	2,16
#02	0,49	4,13	3,04	0,33	2,27	1,75
#03	0,48	3,92	2,98	0,33	2,67	1,88
<b>Average</b>	<b>0,48</b>	<b>3,90</b>	<b>2,95</b>	<b>0,37</b>	<b>2,53</b>	<b>1,93</b>

### ROUGHNESS example on Ring Gear

Before USP

Pre - Peening						
Measure	Transval direction			Longitudinal direction		
	Ra [μm]	Rt [μm]	Rz [μm]	Ra [μm]	Rt [μm]	Rz [μm]
#01	0,49	4,28	3,57	0,05	0,51	0,42
#02	0,50	4,60	3,55	0,09	0,69	0,59
#03	0,51	4,24	3,47	0,04	0,47	0,31
<b>Average</b>	<b>0,50</b>	<b>4,37</b>	<b>3,53</b>	<b>0,06</b>	<b>0,56</b>	<b>0,44</b>

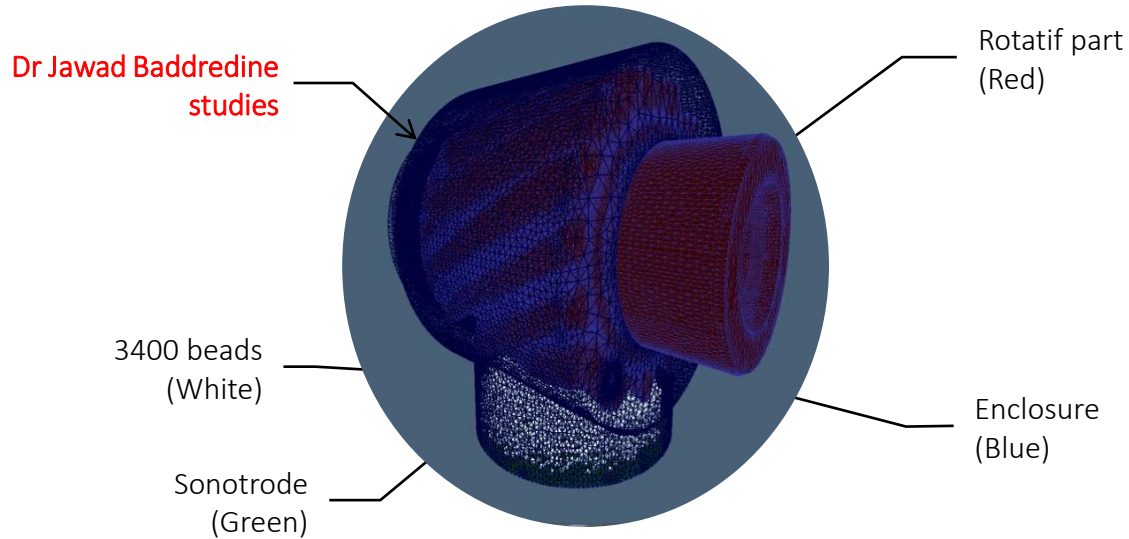


After USP

Post-Peening by STRESSONIC® - C#01						
Measure	Transval direction			Longitudinal direction		
	Ra [μm]	Rt [μm]	Rz [μm]	Ra [μm]	Rt [μm]	Rz [μm]
#01	0,49	3,73	3,01	0,47	3,02	2,27
#02	0,50	3,32	2,86	0,48	2,97	2,47
#03	0,49	3,42	2,94	0,44	3,32	2,54
<b>Average</b>	<b>0,49</b>	<b>3,49</b>	<b>2,94</b>	<b>0,46</b>	<b>3,10</b>	<b>2,43</b>



### Numerized simulation of crankshaft treatment





### 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<sub>2</sub> 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***

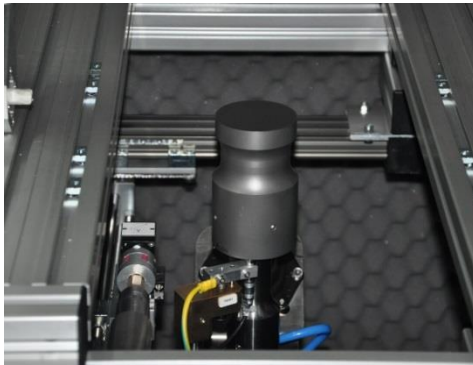




### Dimensional limits

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



### Treatment time

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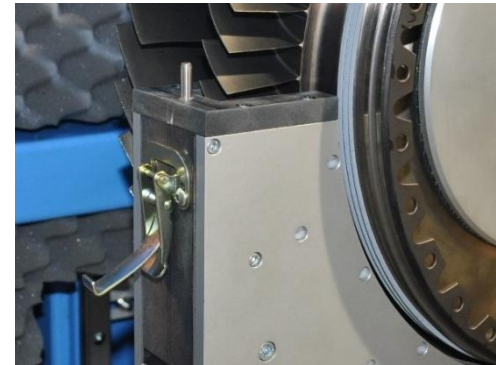
In some treatment configurations, a lower energy given and a lower media quantity can generate a longer treatment time for a same intensity. Shorter global cycle still enables most of the time to reach a shorter operation time



### Chamber design

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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)



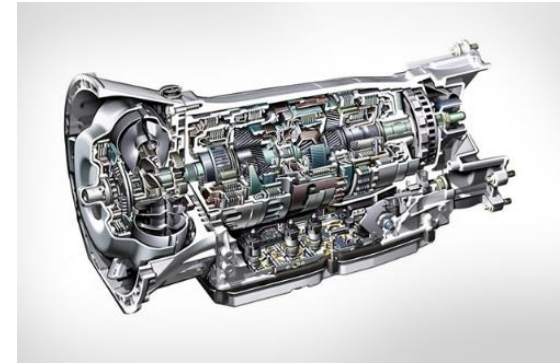


### Context

The automotive supplier wanted to **integrate in its production line** (reduce space) an automated shot peening machine to increase the fatigue life cycle of output shaft parts.

### Solution

Development with the client of an **automated, high speed machine processed with ultrasonic shot peening** to be integrated in the plant

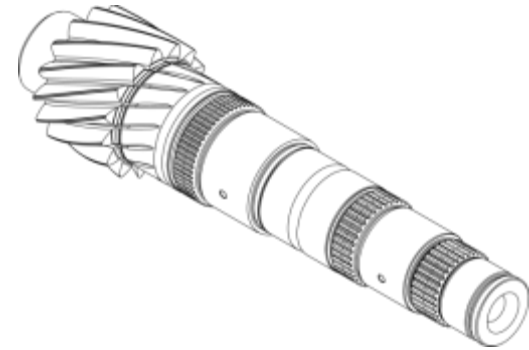


### Benefits

Conservation of Lean structure of the production chain, gain in treatment quality and homogeneity

### Results

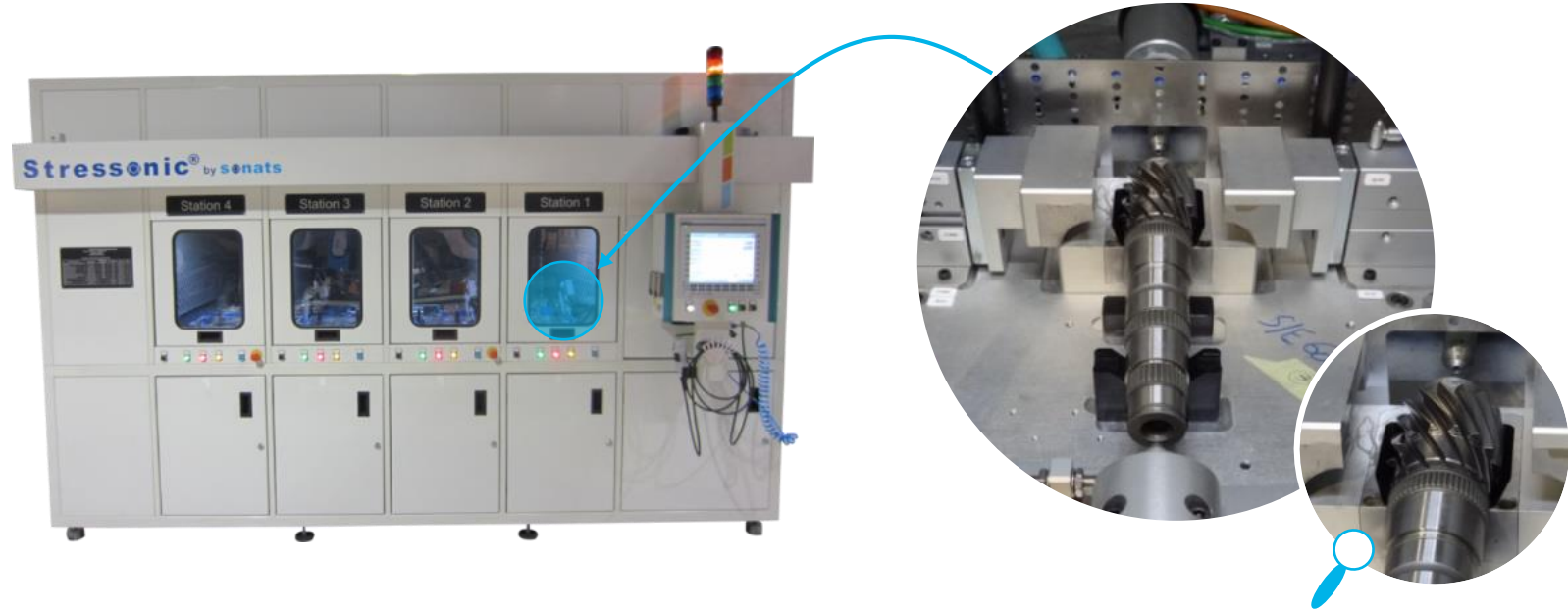
Treatment rate of 1000 parts per day without human intervention





### USP 4-station machine for Ring Gears/Pinions/Shfts

Robotized loading, automated counting and distribution of beads, complete supervision, quality reports





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## Industrial Exemples

*Customized machine (Automotive)*







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## Industrial Exemples

*Customized machine (Automotive)*





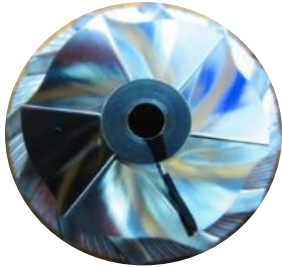
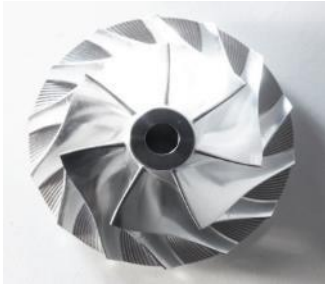
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## Ultrasonic Shot Peening *Industrial Process – Automotive (2)*

### Compressor Wheels / Impellers

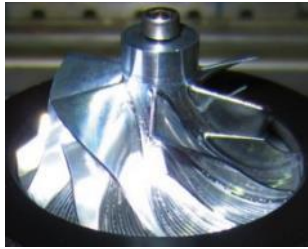
**Turbocharger Compressor Wheels**



**Alumine**



**Truck**



**Car**

**Helicopter engine impeller (Inconel)**



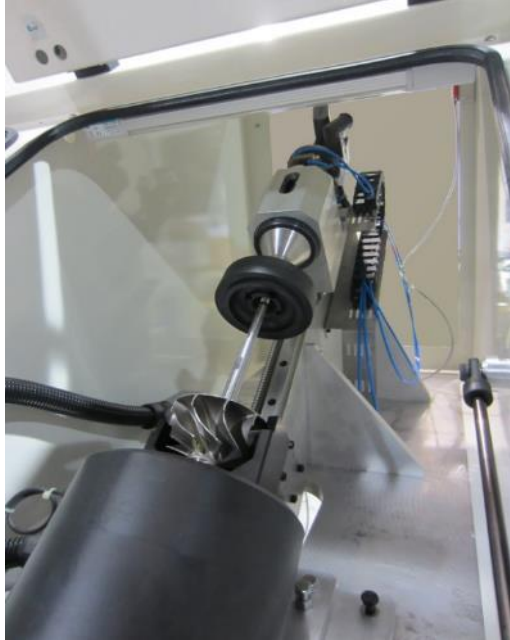


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## Ultrasonic Shot Peening *Industrial Process – Automotive (2)*

### Automotive Turbowheel Production toolings



TW Blade face module



TW Rear face module

- Production toolings are equipped with automated movement sensors and controllers.
- Part could be manually handled or by robot



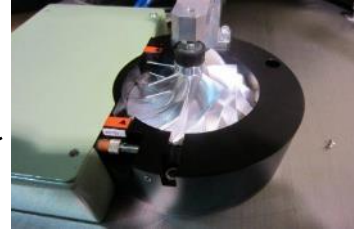


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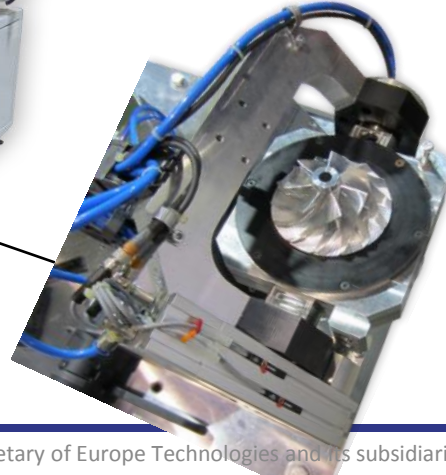
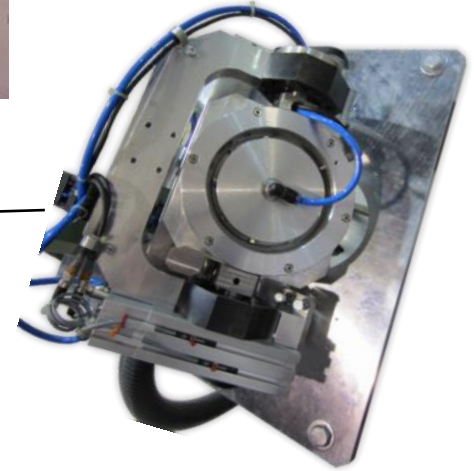
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## Ultrasonic Shot Peening *Industrial Process – Automotive (2)*

### USP 3-station machine for Compressor Wheels



CW Rear module



CW Blade modules

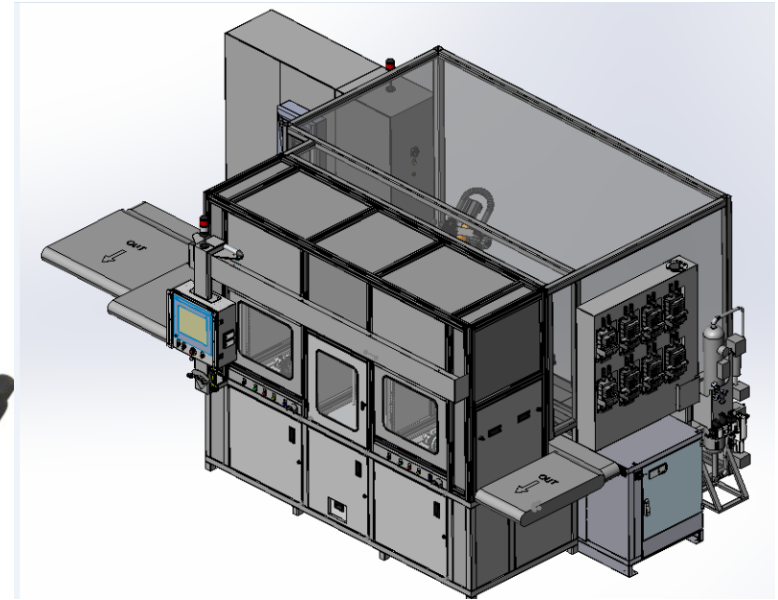


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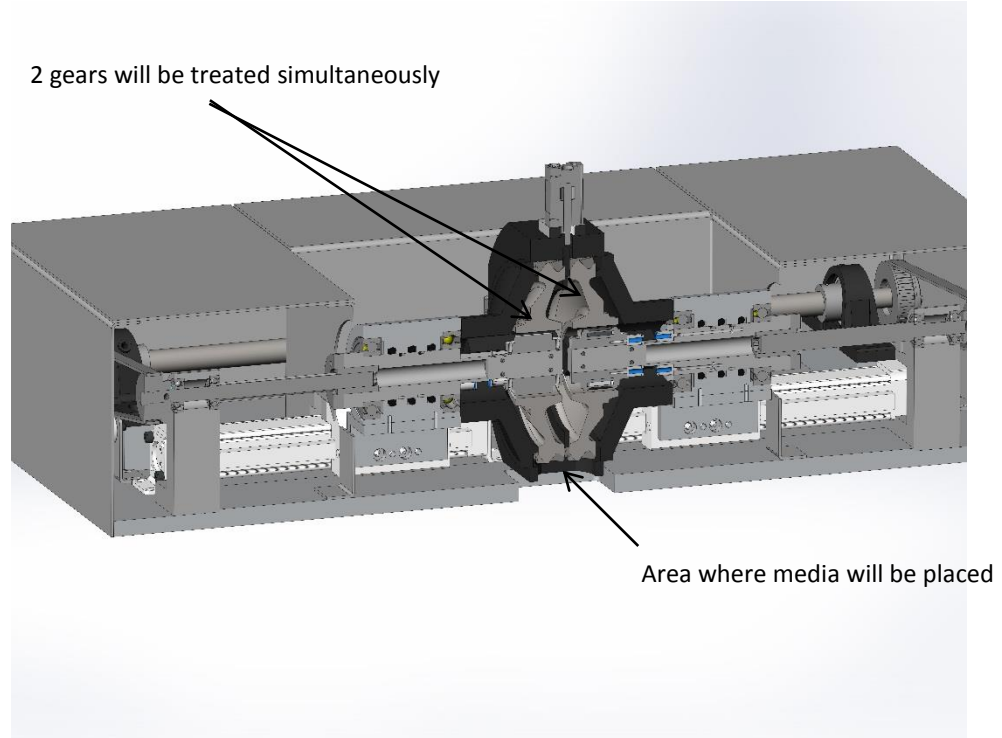
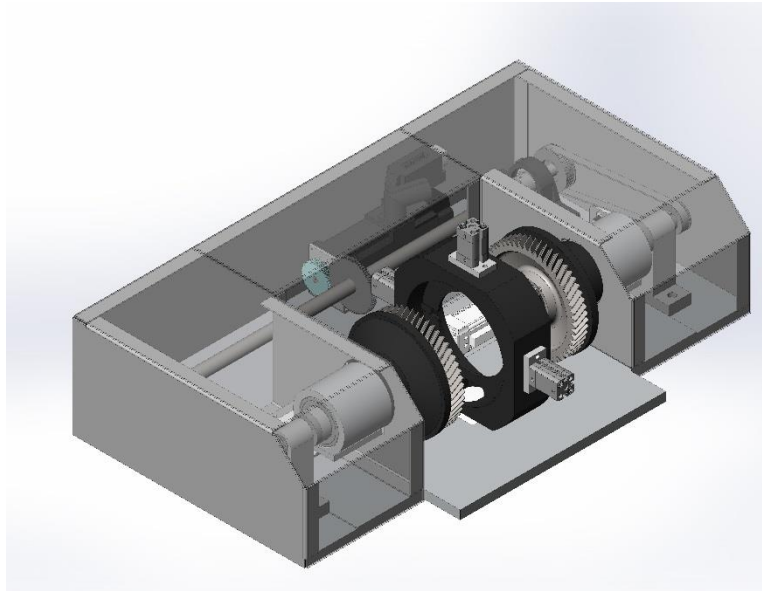
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## Ultrasonic Shot Peening *Industrial Process – Automotive (3)*

### USP 2-station machine for Ring Gears/ Pinions



## Shot Peening on Gear



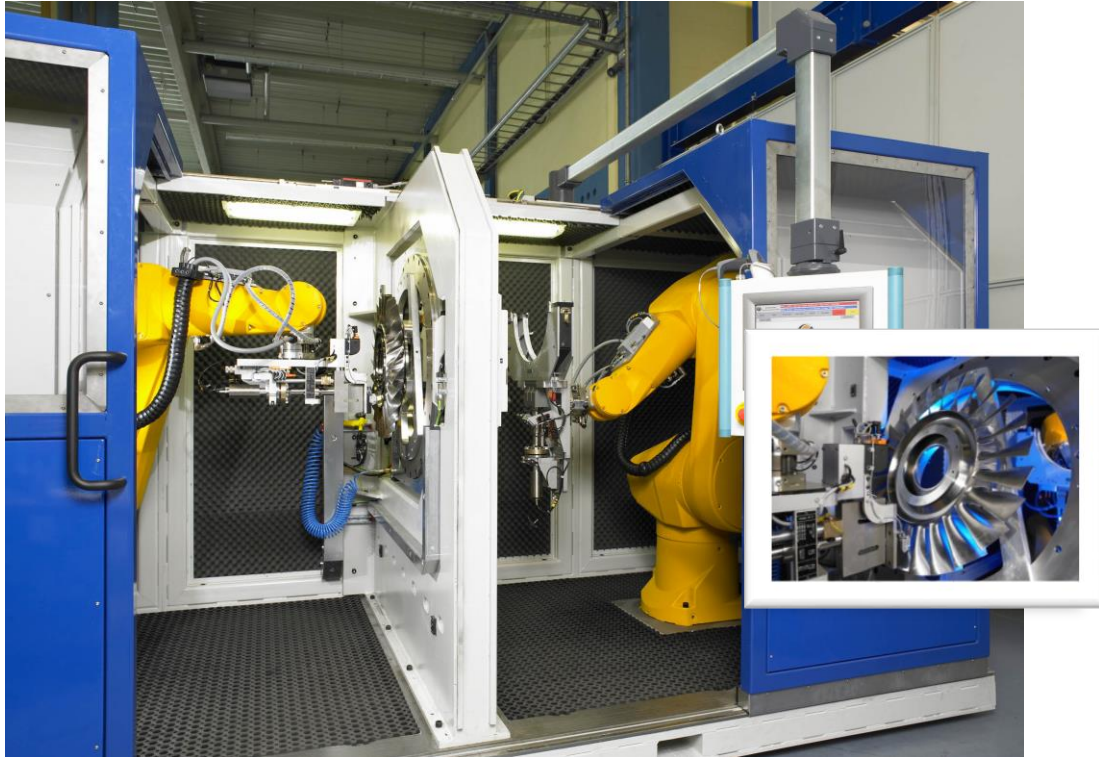


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## INDUSTRIAL EXAMPLES

*Aerospace Applications*



Ultrasonic Shot Peening  
Machines and Robotized  
Cells for **Blisks & Disks**  
treatment



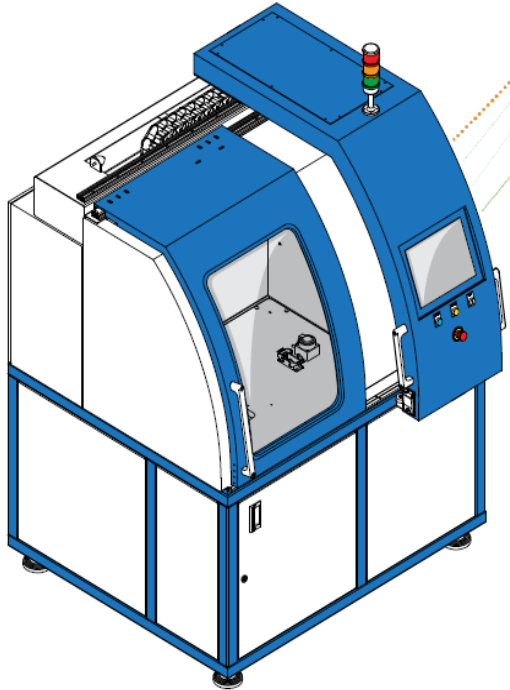


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## INDUSTRIAL EXAMPLES

*Aerospace Applications*



Ultrasonic Shot  
Peening Machines  
for **Aircraft Engine  
Impellers & Small  
Blisks** treatment



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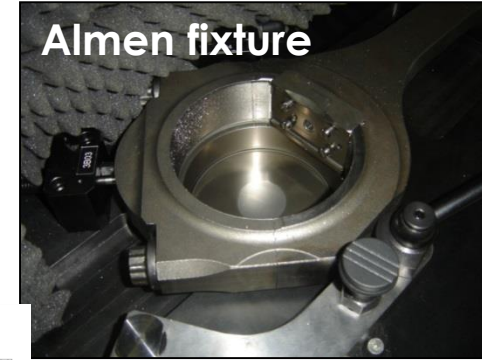
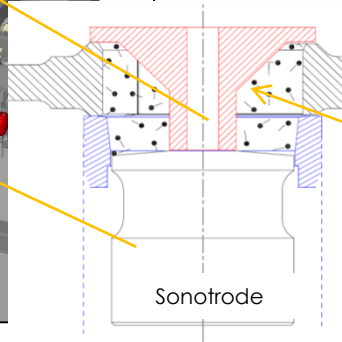
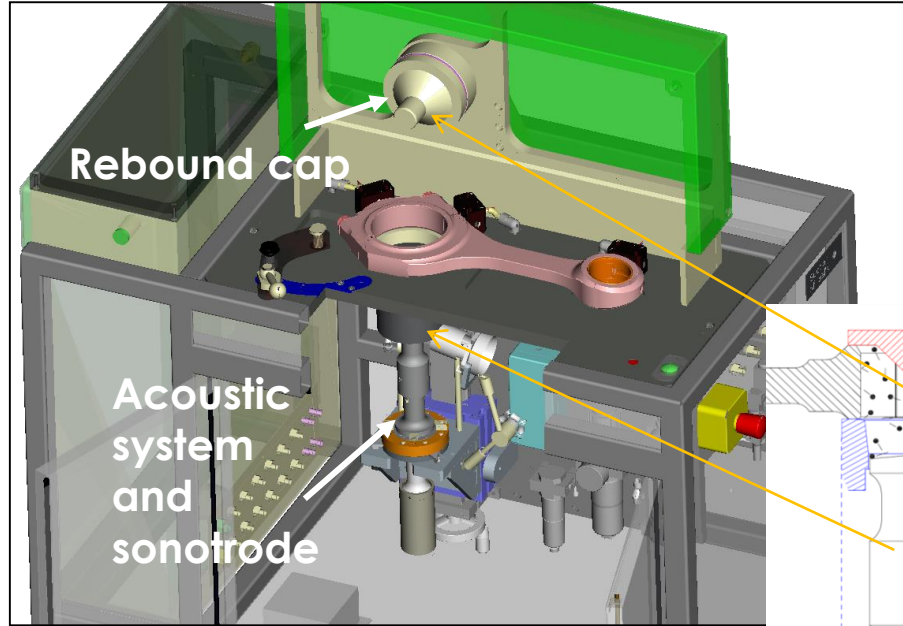
## INDUSTRIAL EXAMPLES *Aerospace & Energy Applications*



Ultrasonic Shot  
Peening Machine  
for **Blade Roots**  
treatment

**Fully robotized  
machine**

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Balls are moving from the vibrating sonotrode to the bore areas thanks to the rebound cap









## Simplified Layout of Stressonic® machine for Crankshafts





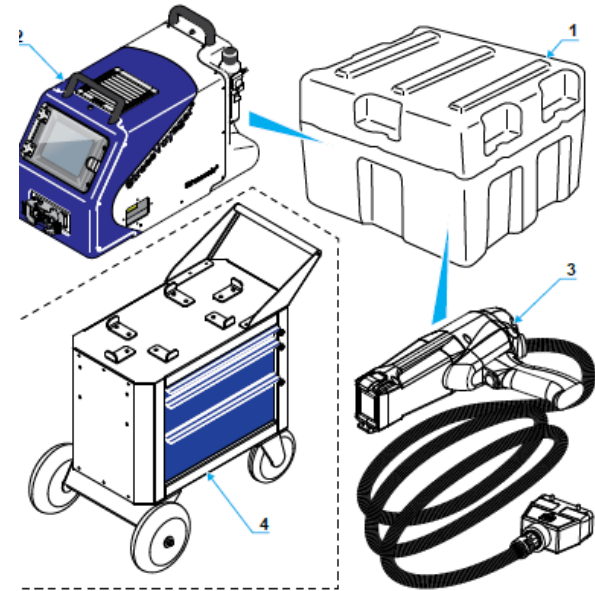
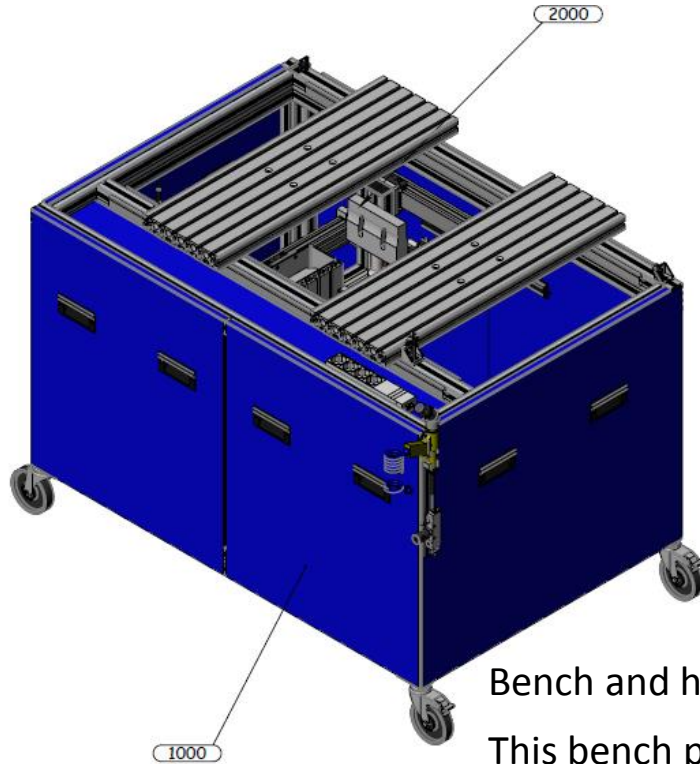
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Bench for trials or small serial production

## Ultrasonic Shot Peening

*Handheld Unit or Bench*



Bench and his acoustic element with a StressVoyager USP.

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



## 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 automatized and robotized industrial equipment

### **Safe & Green**

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





### Targets

Shaping the part according to the drawing

### Distorsion origins

- Machining, welding, grinding...
- Thermal treatment

### Straightening method

- Press, shrinkage, rolling,
- Local rolling, shot peening,
- Hammering or other impact methods.





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## Mechanical impact treatment aiming at:

- Enhance welds mechanical performance :
  - Increase fatigue life
  - Increase fatigue limit
  - Decrease weight of the welded assembly in design phase
  - Improve SCC resistance

## Main targets

- Modifications of the weld toe geometry
- Beneficial Residual stresses introduction

## Ultrasonic Needle peening





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### Shot Peening Training



**SHOT PEENING AND ROTARY FLAP PEENING  
QUALIFYING WORKSHOP**  
- with FAA Courses and Certifications

# FAA Shot Peening Workshop

## *Ultrasonic Shot Peening*



**Nantes, France**  
**November 2019**



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