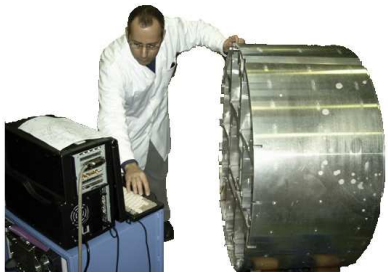
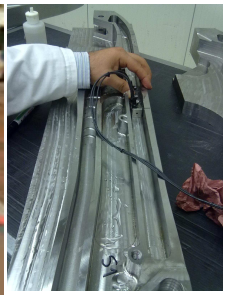
Measurement of Stress by Ultrasounds

- *Rapide*
- *Economical*
- *Simple*
- *Portable*
- *No destructive*

Ultrasonic Technique and Device for Stress Determination

The residual stress measurement of components allows industrials to get an important information on the design and manufacturing. The residual stress could have an impact on the strength capacity and fatigue behavior of component. This is relevant especially for companies that subject their manufactured parts to heat treatment, mechanical treatment or welding operations.





ULTRA RS offers an efficient and accurate tools for the stress analysis in mechanical components, including the following service on site or at ULTRA RS premises:

* The study and the set up of the specifications with client collaboration;
* The development of the measuring devices depending of the customer specification;
* The qualification of the ultrasonic method;
* Control of parts and interpretation of the results;
* Production of a test report.

ULTRA-RS

NDT for Stress Measurement

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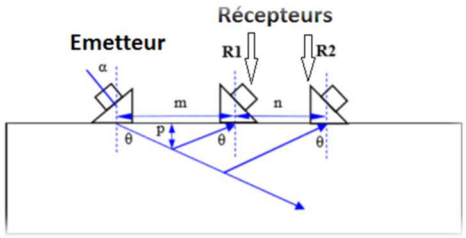
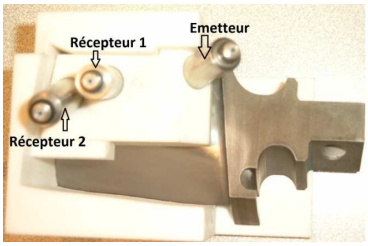
Theoretical approach

Ultrasonic determination of residual stress is based on the dependence of the propagation velocity of the ultrasonic wave with the stress state in the material. When a material is subjected to stress, there is a variation of the propagation velocity of the ultrasonic wave. Residual stress is generally defined as the internal forces that remain in the mechanical parts when they are not subject to any external force.

The determination of the surface residual stresses is realised with the technique of longitudinal subsurface waves (LS) which have the following advantages:

- LS waves are more sensitive to the stresses and less sensitive to the texture and microstructure;
- LS wave is concentrated at the interface with an angle θ. The amplitude at the surface (θ_0 = 90°, parallel to the surface) is smaller than the amplitude corresponding to θ, which suggests that the LS wave is insensitive to surface defects;
- the greatest sensitivity to stress is observed for a longitudinal wave propagating parallel to the direction of the applied stress;
- LS technique does not require samples with parallel faces, so does not impose a strict geometric limitation of the parts.





Formula used:

$(V_{11} - V°_{11})/V°_{11} = K_1 \cdot \sigma_{11} + K_2 \cdot \sigma_{22}$

$V°_{11}$: propagation velocity of the LS wave at reference state in the X1 direction

σ_{11}, σ_{22} : stresses

V_{11} : propagation velocity of the LS wave, in the presence of stresses (σ11, σ22) in the direction X1

K_i : acoustoelastic coefficient of the LS wave

Two calibrations are necessary

1. K_i : on a tensile machine (only once for each type of material)
2. $V°_{11}$: on a reference part characterised with a semi-destructive method (hole drilling method for example)