

RESIDUAL STRESSES MEASUREMENTS

Shot Peened surface characterization

The shot peening process forms a compressive layer on the part surface. Residual stress measurement is the most reliable and extensive mean to control this operation. X-ray diffraction or hole-drilling-strain-gage method can be implemented. Both methods are proposed by SONATS laboratory.

Residual stresses measurement applies to every compressive residual stresses processes :

- Conventional shot peening
- Sandblasting
- Ultrasonic shot peening

- Laser shock peening or water jet peening
- Roller burnishing, deep rolling, isotropic finishing ...

OBJECTIVES OF SHOT PEENING RESIDUAL STRESS MEASUREMENT

- Process control
- Product characterization (≠ monitoring process and Almen Test)
- Quantitative results (MPa or ksi stress values)
- Acurate study of treatment homogeneity
- Measure in a localized area of interest
- Comparison before and after shot peening
 Acauisition of residual stresses profiles
- Comparison of results regarding the technical literature
- Optimization of shot peening parameters
- Definition of control specifications



A SERVICE FOR EVERY NEED

Single test program

- According to your specifications and international standards
- In the lab or in-field measurement
- Comprehensive reports

Product-process expertise

- Definition of technical program
- Measurement
- Reports including results, discussion and comparison with databases and technical literatures
- Analysis of process parameters, optimization, recommandations and industrial outlook

Production monitoring

- For quality control
- In the lab or in-field measurement
- Sampling or 100% control of your parts
- Declaration of conformity → Framework contract (volume, price, one day delay)



UNDERSTANDING THE COMPRESSIVE STRESSES

After the mechanical surface treatment process, compressive residual stresses are located on and under the surface. When using shot peening, the stresses appear after plastic deformation of the skin surface caused by the impact of shots. See illustrations 1 to 4 below in figure 2.



3 : The skin material elongation is restricted because of the material continuity with the core of the part. It follows that a compressive stress is applied to the surface.



2: During shot peening process, media are thrown against the surface and affect the first tens of microns.



4 : After shot peening, high compressive residual stresses are located on the material skin. This is balanced by low tensile stresses distributed in the core material.

Figure 2 : Illustrations of the plastic deformation of the parts before, during and after shot peening

XRD MEASUREMENTS AND ALMEN INTENSITY

Measuring the profile of residual stresses allows to quantify the compression on the treated surface (figure 1 - front page):

- superficial stress
- compression peak (value and depth)
- depth of compression

For constant geometry and material, the profile of residual stresses is related to treatment intensity (figure 3 below).

Residual stress measurement is a product control, whereas measuring the Almen intensity stands for a process control. It enables a quantitative characterization



of the treatment intensity over the material. Remarks :

- measuring residual stresses fall down when coverage is lower than 80%
- intensity can decrease locally (i.e depending on the orientation of the surface or a small radius).
- the level of stresses before shot peening can affect residual stresses after shot peening

Additional services for material characterisation **Three-dimensional measurements** + Geometry before and after treamtent, deformations. Coverage checking Performed by a qualified shot peening expert and com-Microhardness / Metallographic analysis pliant with current standards. Hardness improvement, microstructure changes, surface defects (micro-cracks, folds) **Roughness and Profile control** Parameters Ra, Rt, Rz, etc. geometry, bending, defects Metallurgical expertise / Failure analysis Shot peening for new materials, nanocristallization, size en depth. fractography, cracking understanding, etc.

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