

# Cyclic Variation of Residual Stress Induced by Machining

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## **Abstract**

In metal cutting, due to the cyclic nature of the chip formation process the forces, temperatures and stresses are not constant, but they vary over each cycle, so as the residual stresses over the machined surface. This cyclic variation of the residual stress has never been measured and, therefore, imposes new experimental challenges. The objective of this work is to search for eventual periodic variation of the residual stresses along the cutting path.

Residual stresses were analyzed in machined specimens along the cutting path using neutron diffraction, at the STRESS-SPEC instrument at FRM II facilities. They were measured in the machined surface layer (1 mm depth) in hoop, axial and radial directions. Two work materials were analyzed: a plain carbon steel, AISI 1045, and an austenitic stainless steel, AISI 316L.

The results show a cyclic variation of the residual stresses, which seems to be evident for the case of the AISI 316L steel. This cyclic stress variation can be easily detected when considering the frequency of the chip formation process, which depends on the work material and cutting conditions. This cyclic residual stress variation could also be caused by the tool vibration during the cutting process. In order to separate these two effects (cyclic nature of chip formation and tool vibration), the frequencies of the chip formation and tool vibration must be identified and isolated.

**Keywords:** Metal cutting; Machining; Residual stresses; Neutron diffraction.

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