



**Experiment title:**  
**Residual Stresses In and Around Electromagnetically  
Installed Rivets in Cold-Expanded Holes**

**Experiment  
number:**  
ME-988

**Beamline:**  
ID31

**Date of experiment:**  
from: 5/12/04 to: 13/12/04

**Date of report:**  
27/2/06

**Shifts:**  
12

**Local contact(s):**  
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*Received at ESRF:*

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**Report:**

The work carried out in this experiment is currently in press as part of the proceedings of Mecasens III, Santa Fe, New Mexico, USA, 17<sup>th</sup>-19<sup>th</sup> October 2005 to be published in the Journal of Neutron Research. Please see the abstract below.

N.B. Complementary neutron diffraction was carried out at ENGIN-X, ISIS in the UK. This enabled stress calculations to be made as described in the paper.

**ABSTRACT:**

The residual stresses in and around riveted joints, formed with an electromagnetic riveter (as used in production of the Airbus A380 wing) have been investigated. Synchrotron X-ray and neutron diffraction were used to assess the stresses introduced into skin panel sections by installation of the fasteners. The stress profiles thus obtained exhibited an annular compressive zone, peaking around 400 MPa, around the fastener hole, balanced by tensile residual stresses (at a maximum of approximately 150 MPa) in the bulk material. The in-plane

stress field was found to resemble that expected around a cold expanded hole. An analytical solution for the residual stresses in an autofrettaged tube was compared with the stresses around the rivet allowing estimation of the pressures applied by the rivet to the fastener hole during rivet placement. These pressures were related to the yield stress of the skin material being riveted. This pressure produces a plastic misfit around the hole which places the rivet/hole interface under significant hoop compression. This compressive region is expected to confer significant advantages in terms of the fatigue lifetime of the riveted joints.