Image Cover Sheet

CLASSIFICATION	SYSTEM NUMBER 511918
UNCLASSIFIED	

TITLE

Current Developments in Residual Stress Measurement by Invasive But Nondestructive Methods. Is the Complementarity There?

System Number:

Patron Number:

Requester:

Notes: Paper #44 contained in Parent sysnum #511874

DSIS Use only:

Deliver to: CL

Current Developments in Residual Stress Measurement by Invasive But Nondestructive Methods. Is the Complementarity There?

by G. Roy [1], J. Porter [2], T. Holden [3], and J., Pineault [4]
[1] CANMET/MTL, [2] DREA, [3] NRC, and [4] Proto

ABSTRACT

Four methods of nondestructive residual stress determination, X-ray Diffraction (XrD), Neutron Diffraction, Magnetic Barkhausen Noise (MBN), and Acousto elasticity using Electromagnetic Acoustic Transducers (EMAT) were used to determine residual stress in a steel plate. The results were compared with analytically calculated and Finite-Element-Method computed stress distributions, based on the plate geometry and boundary conditions, such as forces and displacements.

The plate material was ASTM A517 steel (Grade 117), with an upper yield strength of 810MPa, and its chemical analysis confirmed the low-alloy composition, except for a substantially lower value of Cu, 0.19 instead of 0.40. Its elastic constants, (determined from tensile test specimens) were, Young's modulus, 225GPa, and Poisson's ratio, 0.28. The nominal dimensions of the plate were 610mm (length) x 305mm (width) x 12mm (thickness)

The plate was subjected to a strain-gauge controlled four-point bending beyond the yield strength, and unloaded. After elastic spring back, the plate was in a state of residual stress in a central part of 150mm(length) x 300mm (width).

There was a two-part objective of this study: 1) to assess the accuracy of the methods on a known stress state, and 2) to determine the degree of complementarity of the methods.

The results indicate an adequate correlation between the determined stress states within acceptable engineering error bounds of 5-10%.