Effect of sheet material properties on residual stress profile in Self-Pierce Riveted joint

Rezwanul Haque[a], Yvonne Durandet[a] and Anna Paradowska[b]

[a] Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, VIC, Australia

[b] Australian Nuclear Science and Technology Organisation (ANSTO), NSW, Australia

Self-Piercing Riveting (SPR) is a high-speed mechanical fastening technique which does not require pre-drilling. During SPR, a tubular rivet is driven through the top sheet, piercing the bottom sheet without breaking through it, accompanied by flaring of the legs in the bottom sheet under the guidance of a suitable die. The rivet material should have adequate hardness to pierce the sheets, and sufficient ductility to deform in the bottom sheet without cracking, thus producing a mechanical interlock between the sheets. An increase in strength or thickness of the ply materials narrows down the operating window in terms of joint quality and performance. It is important to know the residual stress distribution arising from the riveting process, and its dependence on the ply materials properties, to ensure a sound joint.

In this study, four different joints consisting of two different hardnesses of materials and two different hardnesses of rivets were examined. Residual stresses were measured on the strain scanner Kowari at ANSTO at selected critical locations. The study revealed that the hardness of the rivet and a ply material influence the magnitude and distribution of compressive residual stress in the rivet joint. It was observed that the maximum compressive residual stress occurred in the rivet leg in the transverse direction relative to plane of sheet. The challenges related to the application of neutron diffraction technique to the measurements of residual stress in the riveted joints are presented and discussed.