Nondestructive techniques using principles of diffraction are the most reliable methods of measuring residual stresses. This paper highlights the use of Positron Annihilation Spectroscopy and Neutron Diffraction Method for residual stress measurements on Type 304 stainless steel, which is a target material used for transmutation applications. An attempt is also underway to validate these results using a destructive Ring Core Method. Residual stresses are induced in this material by three point bending, welding and cold deformation.

The Positron Annihilation Spectroscopy has proved to be a very precise nondestructive technique for evaluation of open volume defects. The purpose of this investigation is to develop a highly penetrating sensitive probe for residual stress evaluation in thick materials based on γ-ray induced positron annihilation spectroscopy.

Neutron Diffraction Method is a nondestructive measurement of residual stresses in the interior of components due to the high penetration depths of neutrons. The scattering of neutron beams by engineering materials offers a means of measuring stresses in actual engineering components. The method enables the determination of complete stress tensors to depths of several millimeters below the surface.

The ring-core method is a mechanical/strain gage technique employed to describe the principal residual stress field as a function of depth in polycrystalline or amorphous materials. The method involves placing a strain gage rosette at the surface at the location of interest on a give component. An annular groove is machined around the strain gage rosette at predetermined depth increments. The strain relaxation, which occurs as a function of machined depth, is recorded. An on-line computer controls the entire process. The final residual stress values are calculated using the measured change in strain with depth.

Residual stresses are currently being measured by all three techniques at The Idaho Accelerator Center (Pocatello), Los Alamos National Laboratory (New Mexico) and Lambda Research (Cincinnati). Although no experimental date is available at this time, comprehensive results obtained form these testing will be presented at the TRP conference.