

ACCURATE SPECIMEN MOUNTING AND ALIGNMENT FOR NEUTRON
STRAIN MAPPING AT ORNL

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The High Flux Isotope Reactor (HFIR) and the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory are two of the highest flux sources of neutrons for neutron scattering in the world. Engineering and materials science diffractometers are to part of the instrument suite at each facility. The new instrument at HFIR is the recently commissioned and operating 2nd generation Neutron Residual Stress mapping Facility, NRSF2, which excels at high resolution strain mapping and in situ, real time measurements within the bulk of samples. At SNS the world-class Engineering and Materials Science Diffractometer VULCAN is nearing completion and will receive neutrons later this year. The two facilities are accessible to users from other institutions through corresponding User Programs. To take advantage of the exceptional performance and to improve accuracy, specimen mounting, alignment and experiment planning tools are being assembled and developed for use at both facilities.

The specimen set up/mounting is based on modular, T-slotted profiles of high strength aluminum that can be rapidly assembled. The T-slotted profiles are 25 mm in cross section and conform to 50 mm M-6 hole pattern on the XYZ sample positioner system. The specimen alignment tools include laser trackers and a laser ScanArm-coordinate measuring system. These tools help define the origin of the sample and its relationship to fiducial points on the sample or the sample mount. The measurements provide the as-received sample geometry, which can be compared to engineering drawings or be used to “reverse engineer” and develop as-is drawings of the specimen. One output of the ScanArm measurements and data processing is the deviation from the ideal geometry that is determined to approximately +/- 50µm. This actual 3-D surface geometry is then entered into SScanSS, a software tool written at Open University for neutron strain mapping experiment planning and optimization. SScanSS is a virtual instrument simulation tool for sequential robotic motion positioners that assists the user to define of the desired measurement locations, consider beam path length, and assure the measurement plan is free of collision. When the sample is mounted on the diffractometer’s sample positioning system (SPS), the fiducial locations are remeasured and SScanSS creates the command file for driving the SPS. This improves accuracy in positioning the sample and relating the measurement location back to engineering drawings of the sample. Such knowledge is proving valuable to groups validating finite element analysis models with neutron strain/stress mapping results.