# Determination of J-Integral of Material EN-GJS-400-15 by Sample Form DCT9

Weiguo Ji, Erich Schubrikoff, Gontermann Peipers GmbH

According to International Atomic Energy Agency (IAEA) regulations, transport containers for spent fuel must be constructed to prevent brittle fracture. It is thus necessary to determine the fracture toughness properties of container materials like GJS 400.

The American Society for Testing and Materials (ASTM) E1820 proposes methods for determining fracture toughness properties, including the J-Integral, for different types of test specimens. The compliance functions for determining crack lengths depend on the stiffness of the test specimens and were originally developed for ferritic steels with relatively large sample geometries. Due to the limitations of taking samples of material GJS 400 from Castor casks, it is only possible to take Disk-Shaped Compact (DCT) samples of smaller dimensions to determine the fracture toughness properties. The crack length was determined by two different compliance functions given in ASTM 1820 by oscillation and tensile tests of DCT9 specimens. The deviations between calculated and measured final crack lengths were over 15% making it not possible to determine valid fracture toughness values. It was necessary to experimentally determine for DCT9 a typical compliance function of material GJS 400. This compliance function should be valid to determine crack length during oscillation and also during tests by the single-probe method.

Two test series were conducted. One used specimens with different crack lengths loaded to yield level stresses. The other used specimens with the same initial crack length loaded to allow a range of crack elongations. A correlation between the stiffness and the crack length of the test specimens was established. Based on these data, a compliance function was experimentally determined.

Verification tests confirmed that, using the experimentally determined compliance function, the deviations between calculated and measured crack lengths by oscillation and tensile tests were below 15%. Valid J-Integral fracture toughness values were obtained and are well in accordance with the results of other tests with larger sample geometries.