Characterizing the Transition Region of an A508 cl3 Steel Using Small Specimens by the Reference Tempera ture and the Weak-link Distances

Carlos Alexandre de Jesus Miranda
IPEN-CNEN/SP
Travessa R, 400
05508-900, S o Paulo, SP / Brazil
e-mail: cmiranda@net.ipen.br
Phone: (11) 3816-9198
FAX: (11) 3816-9432

Abstract

When working in the transition region it is usual to measure the toughness at cleavage data, J꜀, or its equivalent K꜀ value. In this region the obtained data presents a large scatter that increases with the test temperature and is strongly influenced by the geometry and the specimen size. Smaller specimens produce bigger scatter. So, it is not possible to define a single value J꜀ to characterize the stress field in the crack-tip that could be used as a fracture parameter.

The prediction of J_c or, in other words: the transference of the measured values with laboratory specimens to the actual structures, or to other laboratory geometries, is very difficult. Among the approaches to predict J_c values in the transition associated with one geometry from the values measured with specimens of another geometry there are some deterministic and statistic methods. Among the formers, one that can be mentioned is the Landes methodology that uses the two-parameter J-Q theory and the weak-link concept with its characteristic distance r_{wl} to the crack-tip. Among the statistical methods, the one that can be mentioned is the Master Curve and its Reference Temperature, T꜀, adopted in the ASTM E1921/97 standard. The Master Curve uses the Weibull statistical distribution and the Weak-link concept with the measured values associated with 1T specimens.

An experimental program was developed to characterize the transition region of an A508 cl3 steel. Some fracture mechanic specimens were tested in the transition region using three geometries with B < 1T (CT, SENB and pre-cracked Charpy). Fractographical observations were made in the fracture surfaces to identify the weak-links and to measure their distances to the crack-tip. These distances are compared with the theoretical values that come from the Landes methodology. The results are presented and discussed in terms of the obtained J_c values and the measured r_{wl} distances and the theoretical ones.

Keywords: Transition, Ferritic Steel, J_c Prediction, Weak-link, Fractography, Master Curve, Reference Temperature

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