SCK•CEN CONTRIBUTION TO THE STANDARDISATION OF IMPACT TOUGHNESS TESTS ON PRECRACKED CHARPY SPECIMENS

Background

The application of experimental and analytical procedures for fracture toughness tests at elevated loading rates is presently the focus of several coordinated activities in the framework of standardization committees (ISO, ASTM) and international collaborations (IAEA CRP-8). In particular, emphasis is being placed on dynamic toughness measurements performed on precracked Charpy V-notch specimens tested using an instrumented pendulum.

Objectives

SCK•CEN has performed these tests for many years, and is obviously interested in both following and contributing to the worldwide activities in this field.

Principal results

ASTM

The current version of ASTM E1921 (2005) only allows testing at quasi-static loading rates, by requiring the stress intensity rate dK/dt in the linear elastic regime to be in the range 0.1 – 2 MPa√m/s. Within this range, the reference temperature is expected to be insensitive to the loading rate within 10 °C. Below 0.1 MPa√m/s, testing is allowed provided environmental effects are negligible. No provisions are currently made for dK/dt > 2 MPa√m/s.

The proposal formulated by SCK•CEN to the responsible ASTM committee (E08.08) envisages the extension of the method to higher loading rates, including instrumented impact tests performed on precracked Charpy (PCCv) specimens. Indeed, the applicability of the Master Curve approach to impact toughness tests on PCCv specimens has been fully demonstrated and is now widely accepted.

The new revision of ASTM E1921 is currently under Main Committee ballot.

ISO

During the ISO TC164/SC4F (*Mechanical Testing – Fracture*) meeting which took place at NPL, Teddington (UK) in October 2005, E. Lucon formulated a proposal aimed at the standardization of fracture toughness tests on PCCv specimens tested with an instrumented pendulum. The proposal raised enough interest and a new work item was officially launched; the basis of the document was the latest version of the draft test procedure produced by ESIS TC5 (25.4, December 2005).

The new work item, which was assigned the code N465, was circulated to all committee members by the SC4F secretary in April 2006. Comments were received from Japan, Germany and Brazil. A new version has been produced after the discussion which took place at the ISO TC164 meeting in Pretoria, South Africa (October 2007); this will be circulated in the form of a CD (Committee Draft) at the beginning of 2008, for further comments.

Future work

ASTM

During the recent ASTM E08.08 meeting in Tampa, Florida (November 2007), it was decided to implement the experimental procedure for impact toughness tests on precracked Charpy specimens into a future version of the unified ASTM fracture toughness test method, E1820. The first draft will be discussed during the next meeting in Denver, Colorado (May 2008).

ISO

All the comments to the CD document which will be received in 2008 will be discussed during the next ISO TC164 meeting in Hannover, Germany (October 2008). If no significant unresolved technical issues remain, the document will proceed to the following stage (DIS – Draft International Standard).

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Main reference

E. Lucon and M. Scibetta, "Fracture Toughness Measurements at Elevated Loading Rates - SCK•CEN activities 2007 within ISO, ASTM and IAEA CRP-8 (topic area #2)", External Report SCK•CEN-ER-44, January 2008.