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# WES

Test method for brittle crack arrest  
toughness ,  $K_{ca}$

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# Test method for brittle crack arrest toughness, $K_{ca}$

**Introduction** This standard specifies the test method to evaluate the brittle crack arrest toughness of steel using fracture mechanics parameter.

**1. Scope** This standard is applied to ferrite steel base metals exhibiting ductile to brittle transition behavior. Applicable materials include steel plates and steel pipes. Steel pipes are prepared to be a flat shape in an appropriate manner. It is intended for materials with a tensile strength of 950 MPa or less and a test specimen thickness of 200 mm or less. The range of arrest temperatures is between  $-196^{\circ}\text{C}$  and  $100^{\circ}\text{C}$ .

Setting a temperature gradient in the width direction of a test specimen, and applying uniform stress to the test specimen, strike the test specimen to initiate a brittle crack from the mechanical notch at the side of the test specimen and causes crack arrest (temperature gradient type arrest testing). Using the stress intensity factor, calculate the arrest toughness,  $K_{ca}$ , from the applied stress and the arrest crack length. This value is the arrest toughness at the temperature of the point of crack arrest (arrest temperature). To obtain  $K_{ca}$  at a specific temperature such as the design temperature of a structure, the method specified in **annex A** can be used.

To determine the dynamic behavior of crack propagation and the dynamic strain of a test specimen, the method specified in **annex B** can be used.

As a method for initiating a brittle crack, a secondary loading mechanism can also be used (see **annex C** “Double tension type arrest test”). The arrest characteristics of a test specimen can also be evaluated by connecting a crack starter plate and the test plate in the width direction through welding to enable a brittle crack initiated from the mechanical notch at the side of the test specimen to propagate in the crack starter plate, and by observing the propagation behavior of the crack immediately after entering the test plate (see **annex D** “Duplex type arrest test”).

**2. Normative references** The following standards contain provisions, which, through references in this standard, constitute provisions of this standard. Their latest versions shall apply.

**JIS G 0202** Glossary of Terms Used in Iron and Steel (Testing)

**JIS Z 3001** Welding Terms

**3. Terms and definitions** Major terms and definitions used in this standard are in conformity with **JIS G 0202** and **JIS Z 3001-1, 2, 3, and 4**, as well as the following:

- (1) **Brittle fracture** In general, fracture generated in a low stress and low deformation state is called brittle fracture. This standard specifies the test method of ferritic steel exhibiting ductile to brittle transition, and hence it limits brittle fracture to that caused by cleavage fracture.
- (2) **Brittle crack** Crack propagating due to brittle fracture is called a brittle crack. The crack propagation velocity is approximately 200 - 300 m/s or more.
- (3) **Arrest** It means the phenomenon that a brittle crack propagating at a high velocity stops.