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Corrosion of metals and alloys — Stress corrosion testing —

Part 9: Preparation and use of pre-cracked specimens for tests under rising load or rising displacement

Corrosion des métaux et alliages — Essais de corrosion sous contrainte —

Partie 9: Préparation et utilisation des éprouvettes préfissurées pour essais sous charge croissante ou sous déplacement croissant

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7539-9 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

ISO 7539 consists of the following parts, under the general title *Corrosion of metals and alloys — Stress corrosion testing*:

— *Part 1: General guidance on testing procedures*

— *Part 2: Preparation and use of bent-beam specimens*

— *Part 3: Preparation and use of U-bend specimens*

— *Part 4: Preparation and use of uniaxially loaded tension specimens*

— *Part 5: Preparation and use of C-ring specimens*

— *Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement*

— *Part 7: Slow strain rate testing*

— *Part 8: Preparation and use of specimens to evaluate weldments*

— *Part 9: Preparation and use of pre-cracked specimens for tests under rising load or rising displacement*

Corrosion of metals and alloys — Stress corrosion testing —

Part 9:
Preparation and use of pre-cracked specimens for tests under rising load or rising displacement

1 Scope

1.1 This part of ISO 7539 covers procedures for designing, preparing and using pre-cracked specimens for investigating the susceptibility of metal to stress corrosion cracking by means of tests conducted under rising load or rising displacement. Tests conducted under constant load or constant displacement are dealt with in ISO 7539-6.

The term “metal” as used in this part of ISO 7539 includes alloys.

1.2 Because of the need to confine plasticity to the crack tip, pre-cracked specimens are not suitable for the evaluation of thin products such as sheet or wire and are generally used for thicker products including plate, bar and forgings. They can also be used for parts joined by welding.

1.3 Pre-cracked specimens may be stressed quantitatively with equipment for application of a monotonically increasing load or displacement at the loading points.

1.4 A particular advantage of pre-cracked specimens is that they allow data to be acquired from which critical defect sizes, above which stress corrosion cracking may occur, can be estimated for components of known geometry subjected to known stresses. They also enable rates of stress corrosion crack propagation to be determined.

1.5 A principal advantage of the test is that it takes into account the potential impact of dynamic straining on the threshold for stress corrosion cracking.

1.6 At sufficiently low loading rates, the K_{ISCC} determined by this method can be less than or equal to that obtained by constant load or displacement methods and can be determined more rapidly.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7539-1:1987, *Corrosion of metals and alloys — Stress corrosion testing — Part 1: General guidance on testing procedures*

ISO 7539-6:—[1)], *Corrosion of metals and alloys — Stress corrosion testing —Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement*

1) To be published. (Revision of ISO 7539-6:1989)

ISO 7539-7:—[2], *Corrosion of metals and alloys — Stress corrosion testing — Part 7: Slow strain rate testing*

ISO 11782-2:1998, *Corrosion of metals and alloys — Corrosion fatigue testing — Part 2: Crack propagation testing using precracked specimens*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7539-6 as well as the following apply.

3.1
rate of change of crack opening displacement at loading plane
$\dot{V}_{\mathrm{LL}}$
deflection at the loading point access measured over a fixed period

3.2
stress intensity factor at crack initiation
$K_{\mathrm{I\text{-}init}}$
stress intensity applied at the commencement of measurable crack growth

3.3
range of stress intensity factor
ΔK_{f}**, in fatigue**
algebraic difference between the maximum and minimum stress intensity factors in a cycle

3.4
displacement rate
$\mathrm{d}q/\mathrm{d}t$
rate of increase of the deflection either measured at the loading point axis or away from the loading line

4 Principle

4.1 The use of pre-cracked specimens acknowledges the difficulty of ensuring that crack-like defects, introduced during either manufacture or subsequent service, are totally absent from structures. Furthermore, the presence of such defects can cause a susceptibility to stress corrosion cracking, which in some materials (e.g. titanium) may not be evident from tests on smooth specimens under constant load. The principles of linear elastic fracture mechanics can be used to quantify the stress situation existing at the crack tip in a pre-cracked specimen or structure in terms of the plane strain-stress intensity.

4.2 The test involves subjecting a specimen, in which a crack has been developed from a machined notch by fatigue, to an increasing load or displacement during exposure to a chemically aggressive environment. The objective is to quantify the conditions under which environmentally-assisted crack extension can occur in terms of the threshold stress intensity for stress corrosion cracking, K_{ISCC}, and the kinetics of crack propagation.

4.3 Tests may be conducted in tension or in bending. The most important characteristic of the test is the low loading/displacement rate that is applied.

4.4 Because of the dynamic straining which is associated with this method, the data obtained may differ from those obtained for pre-cracked specimens with the same combination of environment and material when the specimens are subjected to static loading only.

2) To be published. (Revision of ISO 7539-7:1989)

