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Thermoplastics pipes for the conveyance of fluids — Determination of the slow cracking resistance of pipes and fittings using the Notched Ring Test (NRT)

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National foreword

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Thermoplastics pipes for the conveyance of fluids — Determination of the slow cracking resistance of pipes and fittings using the Notched Ring Test (NRT)

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Principle **2**
5 Apparatus **3**
5.1 Loading apparatus 3
5.2 Ring deflection measuring device 3
5.3 Temperature chamber 4
5.4 Test medium 4
5.5 Timing device 4
5.6 Microscope 4
5.7 Notching apparatus 5
6 Test specimen **7**
6.1 Specimen geometry and dimensions 7
6.2 Specimen preparation 7
6.3 Specimen conditioning 9
7 Procedure **9**
7.1 Conditioning 9
7.2 Load application 9
7.3 On-set slow cracking time detection 10
7.4 Notch depth measurement 10
7.5 Number of specimens 10
8 Test report **10**
Annex A (informative) **On-set slow cracking time detection** **12**
Annex B (informative) **Stress intensity factor plot** **16**
Annex C (informative) **Flexure load estimation** **20**
Bibliography **21**

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Foreword

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ISO/TS 16479 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 5, *General properties of pipes, fittings and valves of plastic materials and their accessories — Test methods and basic specifications*.

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Introduction

At the present time ISO/TC 138 provides several test methods for determining the resistance to slow cracking which are essential for assessing properties and durability of thermoplastics pipes and fittings. In fact, they constitute a basis for determining the long term performance characteristics of these parts. In line with the development of better slow crack resistant materials, new accelerated test methods for evaluating slow crack resistance of thermoplastic piping parts are frequently under investigation [1-3]. In consideration of this, the Notched Ring Test (NRT) method has been developed and applied to determine its applicability as the standard test method and has demonstrated its effectiveness in generating slow cracking within the time frame of interest [4-7]. This Technical Specification provides details of the NRT method in terms of test implementation, its SCG performance evaluation, and the application of the method utilizing the stress intensity factor approach.

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Thermoplastics pipes for the conveyance of fluids — Determination of the slow cracking resistance of pipes and fittings using the Notched Ring Test (NRT)

1 Scope

This Technical Specification determines the slow cracking resistance of pipes and fittings using the Notched Ring Test (NRT) which is a method for determining the slow crack resistance of thermoplastics resins and compounds in pipe form and/or finished products (e.g. pipes and fittings) from which a ring specimen can be cut and notched. The test is performed under sustained constant loading in a test medium at a specified temperature and the time to the on-set of slow cracking is measured. This method applies to the rings from pipes or fittings having a wall thickness greater than 5 mm. This Technical Specification specifies the method of testing using notched ring specimens directly obtained from pipes or fittings.

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 6108, *Double equal angle cutters with plain bore and key drive*

ISO 13479, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes (notch test)*

3 Terms and definitions

3.1
slow crack growth
SCG
crack growth that occurs below the critical stress intensity factor at which the unstable rapid crack propagation takes place

NOTE The crack growth is stable and hence can grow to a substantial length before causing material to fail either by rapid fracture or ligament yielding. In some polyolefin materials, distinct fracture surface features characteristic of slow crack growth are apparent and are often used as an indicator of slow crack growth

3.2
ring deflection curve
time dependent deflection curve obtained from the sustained constant flexure loading of the ring specimen

NOTE 1 See Annex A.

NOTE 2 The curve may have similar features of a creep curve, normally consisting of primary, steady state secondary and tertiary regions. Deflection is normally taken at the notch position and directly above the line of load application.

3.3
on-set slow cracking time
t_i (h)
time for first noticeable abnormal change to appear on the recorded ring deflection curve

NOTE 1 See Annex A.

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NOTE 2 For this definition to be complete, the fracture surface must show features of slow cracking in any degree or features defined otherwise.

EXAMPLE Examples of abnormal change are discontinuity, slope change etc.

3.4
applied load
L **(N)**
load applied in three point flexure mode

3.5
applied stress intensity factor
K_0 **(N/m$^{3/2}$)**
crack-tip stress intensity factor calculated based on the initial notch dimension

4 Principle

A suitable NRT specimen is an undisturbed full ring of certain width directly removed from the pipes or fittings (see Figure 1), having features that include an inner wall notch along the sample width between the tips of two coplanar sidewall notches (see Figure 5). The inner wall and sidewall notches are all in the same plane and the notch and specimen dimensions are such that conditions for the plane-strain slow crack growth are met at the notch tip. Coplanar sidewall notches are introduced to further maintain the plane strain condition as well as to act to guide the loading rod accurately along the line of the crack tip. NRT specimens are subjected to sustained and constant flexure load in a temperature controlled medium and the time to on-set cracking as defined in 3.3 is determined from the measured ring deflection curve (see 3.2 and Annex A). In the NRT specimen, the slow cracking can be initiated in a relatively shorter time due to the possibility of constrained crack tip deformation induced by the sample and the loading geometry, hence allowing higher stress intensity to develop at the crack tip without gross yielding.

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