SLOVENSKI STANDARD
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Geosintetika - Preskusna metoda za ugotavljanje odpornosti polimernih geosintetičnih ovir proti razpokam zaradi okoliških napetosti

Geosynthetics - Test method for determining the resistance of polymeric geosynthetic barriers to environmental stress cracking

Geokunststoffe - Prüfverfahren zur Bestimmung der Beständigkeit von geosynthetischen Kunststoffdichtungsbahnen gegen umweltbedingte Spannungsrissbildung

Géosynthétiques - Méthode d'essai pour la détermination de la résistance des géomembranes polymériques à la fissuration sous contrainte environnementale

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59.080.70	Geotekstilije	Geotextiles

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Geosynthetics - Test method for determining the resistance of polymeric geosynthetic barriers to environmental stress cracking

Géosynthétiques - Méthode d'essai pour la détermination de la résistance des géomembranes polymériques à la fissuration sous contrainte environnementale

Geokunststoffe - Prüfverfahren zur Bestimmung der Beständigkeit von geosynthetischen Kunststoffdichtungsbahnen gegen umweltbedingte Spannungsrissbildung

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

European foreword

This document (prEN 14576:2017) has been prepared by Technical Committee CEN/TC 189 “Geosynthetics”, the secretariat of which is held by NBN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 14576:2005.

Introduction

Stress cracking is a phenomenon observed in most thermoplastic materials. It is defined as internal or external cracking of the material caused by tensile stresses less than the short time mechanical strength of the material. Stress cracking may limit the durability of e.g. geosynthetic barriers. In addition to the influence of the stress, stress cracking is accelerated by elevated temperature and the presence of certain molecular species, such as surfactants, in the surrounding environment.

The ability of a material to withstand stress cracking is known as its stress crack resistance. Stress crack resistance is measured by the time required to failure when a specimen of the material is immersed in a particular medium at elevated temperature while under a defined stress. Stress crack resistance is primarily a function of the resin (thermoplastic raw material) type but may be adversely influenced by the geosynthetic barrier manufacturing process particularly certain procedures for friction enhancement.

To meet the requirement to accurately quantify and differentiate the performance of modern resins the Geosynthetics Institute (formerly Geosynthetics Research Institute) developed an alternative method GRI-GM5. The GRI method is frequently referred to as the “notched constant tensile load” (NCTL) test as the apparatus used ensures a constant level of stress in the specimen throughout the test and the specimen is notched to provide a concentration point for stress and failure. The NCTL test is used extensively throughout the geosynthetic barrier industry.

The NCTL test can be performed under two separate procedures that are described in GRI-GM 5(a) and 5(b). In the procedure GRI-GM 5(a), the so-called “full curve test”, specimens are immersed in the test liquid at a range of stresses, typically from 20 % to 65 % of the yield stress of the material. The time to failure and the failure mode (brittle or ductile) is recorded at each level of stress. Failure time is plotted against stress. Typically the resulting curve will show an abrupt change in slope at a point that coincides with a change in failure mode. The time at which this occurs is recorded as the “transition time”.

The second variant of the test, GRI-GM 5(b), which is simpler and quicker to perform, is known as the “single point” test. In this case the specimens are tested at 30 % of the measured yield stress of the material at normal room temperature, and the time to failure is recorded. The procedure described in this document is based on GRI-GM 5(b).

1 Scope

This European Standard specifies a test method for screening the resistance of polymeric geosynthetic barriers to stress cracking. The test is applicable to polyethylene based products which meets at least one of the following requirements:

— there is a pronounced yield point;

— density of the final product is > 0,939 g/cm3.

NOTE The described method is suitable for conformance testing of smooth surfaced (non-textured) geosynthetic barriers. However the resistance to stress cracking of the resin used in the manufacture of structured surface materials can be evaluated by carrying out the test where structuring is carried out as a separate processing step, on a preformed smooth surface geosynthetic barrier, the test can be performed on the intermediate smooth material.

The data are suitable for screening and determination of conformity but not for deriving performance data such as lifetime, unless supported by further evidence

2 Normative references

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

EN ISO 527-3, *Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3)*

EN ISO 9862, *Geosynthetics - Sampling and preparation of test specimens (ISO 9862)*

EN ISO 9863-1:2016, *Geosynthetics - Determination of thickness at specified pressures - Part 1: Single layers (ISO 9863-1:2016)*

3 Terms and definitions

Not applicable.

4 Principle

Dumbbell shaped notched NCTL-specimens cut from the polymeric geosynthetic barrier are subjected to a constant tensile load in the presence of a surface-active agent at an elevated temperature. The time to failure of each NCTL-specimen is recorded.

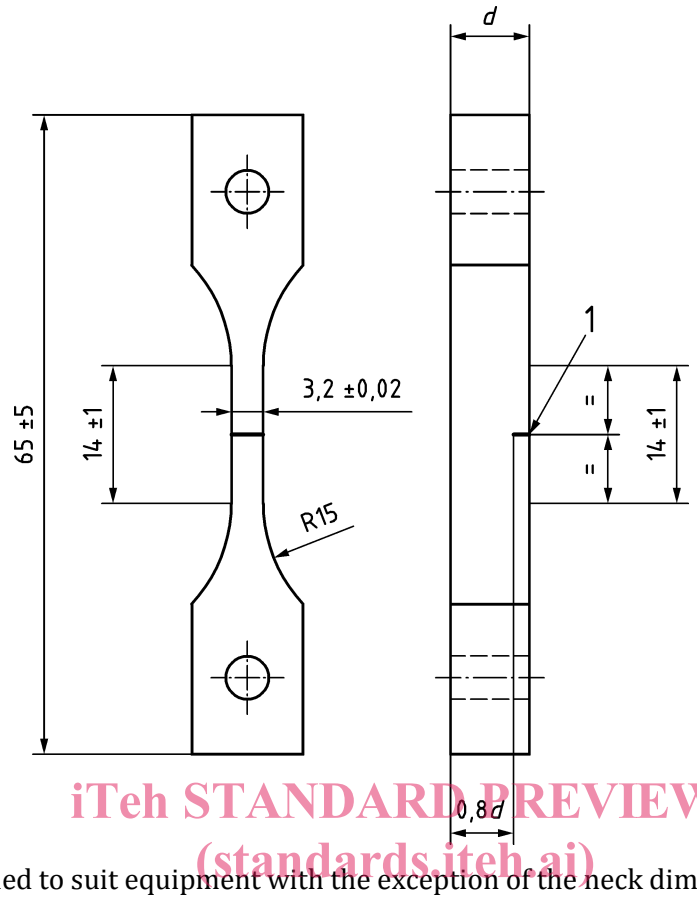
5 Requirements

5.1 Apparatus

5.1.1 Blanking die

A die suitable for cutting NCTL-specimens to the dimensions and tolerances is shown in Figure 1.

The length of the NCTL-specimen can be changed to suit the design of the test apparatus. However, there should be a constant width neck section at least 13 mm long. The width of the neck section should be (3,20 ± 0,02) mm. The tab widths may be enlarged to accommodate grommets of different sizes with which to attach hooks for the purpose of loading.



Dimensions may be varied to suit equipment with the exception of the neck dimensions shown*

Key

d	thickness
d_h	hinge thickness (0,8 × d)
1	notch depth (0,2 × d)

Figure 1 — Dimensions (in millimetres) of NCTL-specimen - left: top view, right: side view

Other specimens may also be used in the test, provided that the parties involved mutually agree to the changes and state the specific details in the final report.

For the application of the test in factory production control (FPC) the test specimen according to Figure 1 is recommended.

5.1.2 Notching device

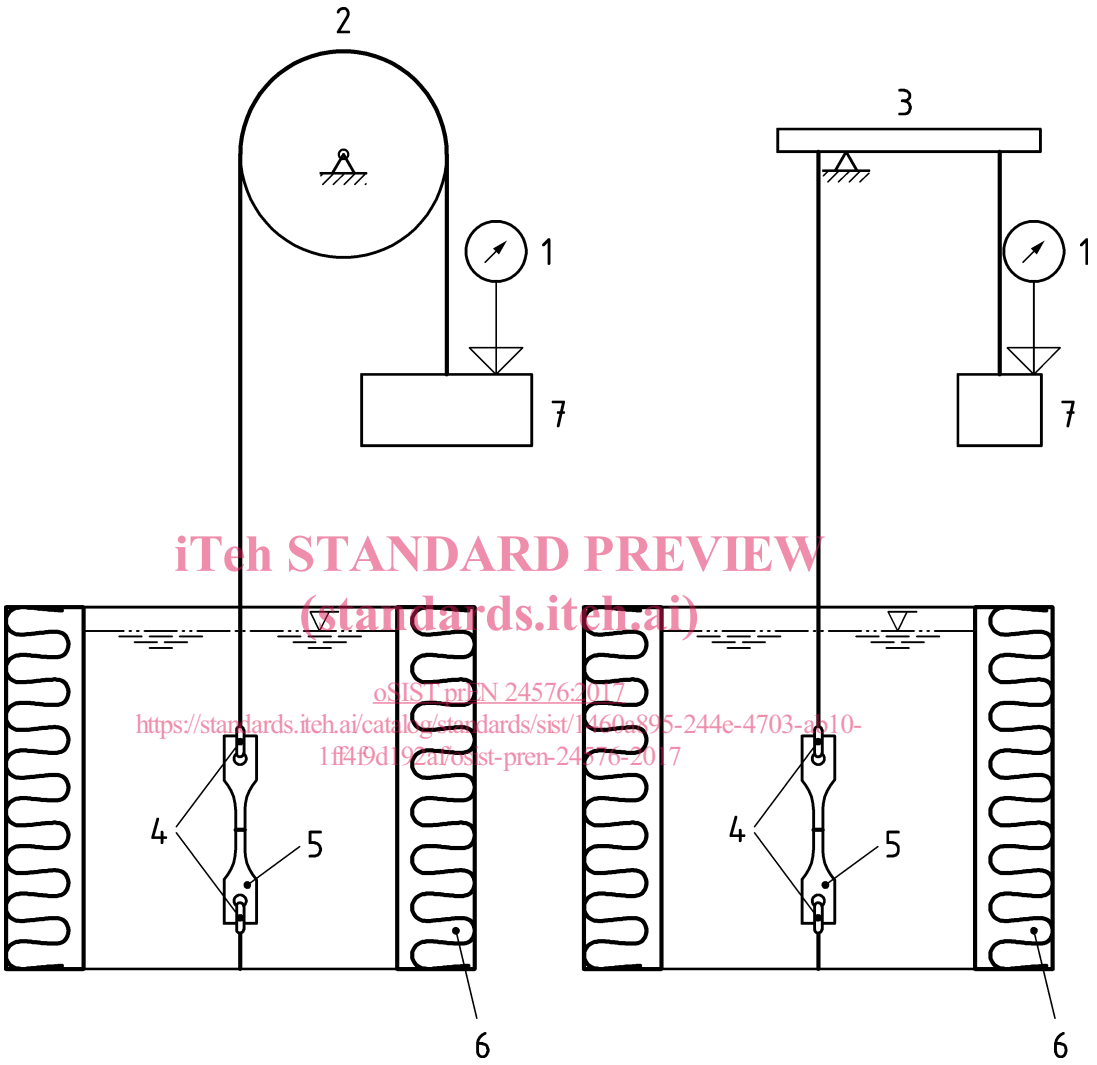
A device or machine that can produce a consistent hinge thickness shall be used.

The notch should consist of a single cut with a thin blade. There should be no removal of the NCTL-specimen material. An evaluation of the depth produced by the notching device is absolutely necessary. Different methods can be used for this evaluation: e.g. quenching a notched specimen in liquid nitrogen and then fracturing it and then measuring the notch depth and the ligament thickness under a reflected light microscope. In this case the notch depth can readily be measured by examining the fracture surface. Or alternatively measuring the notch depth and the ligament thickness from both sides of the NCTL-specimen under light microscope without destroying the specimen.

5.1.3 Stress cracking apparatus

A typical stress cracking apparatus is schematically represented in Figure 2.

The equipment shall be suitable for subjecting multiple NCTL-specimens to a tensile stress of up to 13,8 MPa, using a lever arm and adjustable counterweight system, while they are totally immersed in a surface-active agent contained in an open stainless steel tank.



Key

1 Timer micro-switch
2 Roller
3 Lever arm on pivot
4 Specimen supports
5 Notched NCTL-specimen
6 Immersion tank with heating, insulation and circulation pump
7 Adjustable load

Figure 2 — Typical stress cracking apparatus (left side with roller, right side with lever arm)

The counterweight should be located outside the tank and should be continuously adjustable within the required range. A shot can or similar device would be suitable.

Suitable hooks or clamps are required to secure the NCTL-specimen to the base of the tank and to the lever arm. The equipment shall be capable of constantly agitating the solution by pumping or other means, to provide a uniform concentration throughout the bath while maintaining a constant temperature of (50 ± 1) °C. The equipment should be capable of testing at least five NCTL-specimens at a time. A timing clock for each NCTL-specimen shall be provided to record automatically the termination test time of the NCTL-specimens to the nearest 0,1 h.

If on/off switches are used to control the timing clock, the switch shall be sensitive enough to be turned off under a force of 2 N.

5.2 Test temperatures

The test temperature of the test liquid shall be (50 ± 1) °C for the whole time of the exposure.

Other test temperatures may also be used in the test, provided that the parties involved mutually agree to the changes and state the specific details in the final report.

5.3 Reagent

The reagent shall consist of 10 % by weight of the surface-active agent nonylphenoxy polyethylene-oxyethanol (e.g. Igepal BC-9), diluted with 90 % by weight of deionised or distilled water. The reagent shall be stored in a closed container to maintain a constant concentration.

Other incubation solutions may also be used in the test, provided that the parties involved mutually agree to the changes and state the specific details in the final report.

In order to confirm the activity of the reagent it is recommended to test for example surface tension of the reagent consisting of surface-active agent and distilled water at test temperature before and after the test. A test method for determination of surface tension was described by Kratochvilla et al. [2].

5.4 Test duration

The test shall be continued until all five NCTL-specimens have failed. However, the test may be discontinued if none of the NCTL-specimens have failed after an agreed period of time.

5.5 Specimens

5.5.1 General

The sample from a GBR-P shall be taken in accordance with EN ISO 9862. It shall be taken over the full width of the roll (less than 50 cm distance from the edges) and be approximately 30 cm long in machine direction (MD). The sample shall be taken from the end of the roll provided there is no evidence that it is distorted or different from any other portion of the roll.

5.5.2 Tensile test specimens

Five tensile test specimens shall be cut from the sample. Specimen dimensions shall be as specified in EN ISO 527-3, specimen type 5. Tensile test specimens shall be taken parallel to the cross machine direction (CMD).

Tensile test specimen type 5 dimensions:

— width of test specimen: 6 mm ± 0,1 mm;

— length of narrow section: 33 mm ± 2 mm;

— overall length: ≥ 115 mm;

— overall width: 25 mm ± 1 mm;