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Preskus zvarjenih spojev plastomernih polizdelkov - 3. del: Preskus lezenja pri natezni obremenitvi

Testing of welded joints in thermoplastics semi-finished products - Part 3: Tensile creep test

Prüfen von Schweißverbindungen aus thermoplastischen Kunststoffen - Teil 3: Zeitstand -Zugversuch

Essais des assemblages soudés sur produits semi-finis en thermoplastiques - Partie 3: Essai de fluage en traction

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25.160.40	Varjeni spoji in vari	Welded joints

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Testing of welded joints in thermoplastics semi-finished products - Part 3: Tensile creep test

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 12814-3:2014) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

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

This document supersedes EN 12814-3:2000.

The main changes with respect to the previous edition are listed below:

a) addition of a NOTE for an alternative test using a whole pipe welded sample (Clause 5) making reference to Annex B (informative), Whole pipe tensile creep rupture test;

b) addition of a NOTE for the sampling procedures (Clause 6) in case of socket joints with reference to Annex D (informative), Testing of socket joints.

EN 12814, *Testing of welded joints of thermoplastics semi-finished products*, is divided into the following parts:

— *Part 1: Bend test*;

— *Part 2: Tensile test*;

— *Part 3: Tensile creep test* (the present document);

— *Part 4: Peel test*;

— *Part 5: Macroscopic examination*;

— *Part 6: Low temperature tensile test*;

— *Part 7: Tensile test with waisted test specimens*;

— *Part 8: Requirements*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The design of welded thermoplastics constructions under static load is based on the long-term creep rupture with behaviour, specifically the resistance to slow crack growth of the thermoplastics material and the welds.

For design purposes, the relevant characteristic values for the welded joints are the “long-term tensile welding factors” to which this European Standard provides the test method.

The long-term tensile welding factors are normally used in conjunction with the creep rupture curve of the parent material, given for example in EN 1778, when designing welded semi-finished products under static load.

The long-term tensile welding factor(s), the crack behaviour and the appearance of the fracture surface provide information on the quality of the weld.

NOTE The behaviour of the failure obtained during the tensile creep test can be related to the notch sensitivity of the parent material. An example of a test to provide information about the notch sensitivity of parent material is given in Annex A.

1 Scope

This European Standard specifies the dimensions, the method of sampling and the preparation of the test specimens, and the conditions for performing the tensile creep test perpendicular to the weld in order to determine the long-term tensile welding factor.

A tensile creep test may be used in conjunction with other tests (e.g. bend test, tensile test, macrographic examination, …) to assess the performance of welded assemblies, made from thermoplastics materials.

The test is applicable to welded assemblies made from thermoplastics materials filled or unfilled such as tubes and fittings, sheets, plates and profiles, but not reinforced, irrespective of the welding process used.

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 13100-1, *Non destructive testing of welded joints of thermoplastics semi-finished products — Part 1: Visual examination*

EN ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep (ISO 899-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
test temperature
temperature of the medium surrounding the test specimen during the test

3.2
test stress
test load divided by the minimum cross sectional area of the test specimen

3.3
creep rupture curve
regression curve through the geometric mean values of failure times

3.4
minimum failure time
t_{tm}
creep rupture time of the parent material to ensure that the test method is applicable

3.5
ductile fracture
large scale deformation of material from fracture surfaces

3.6
brittle fracture
little or no deformation of material from fracture surfaces

4 Symbols and designations

Symbols and designations are given in Table 1.

Table 1 — Symbols and designations

Symbols	Designations	Units
a	Minimum measured thickness of test specimen within calibrated and parallel length	mm
a_n	Nominal thickness of test piece	mm
b	Width of calibrated and parallel length of the test specimen	mm
b_1	Width of shoulder of the test specimen	mm
c	Depth of the notch	mm
D_n	Nominal outside diameter of the tube	mm
f_l	Long-term tensile welding factor	
F_s	Value of the force applied to the welded test specimen calculated from the chosen value of σ_s	N
F_t	Value of the force applied to the unwelded test specimen calculated from the chosen value of σ_t	N
L	Total length of the test specimen	mm
L_j	Minimum distance between the clamping jaws	mm
L_0	Calibrated and parallel length of the test specimen	mm
L_w [a]	Maximum width of the weld bead of the test specimen	mm
r	Radius of shoulder of the test specimen	mm
t_{tm}	Minimum failure time	h
σ_s	Value of stress of the welded test specimens used in the calculation of f_l	N/mm^2
σ_t	Reference stress. Value of stress of the unwelded test specimens, used in the calculation of f_l	N/mm^2

[a] For extrusion and hot gas welds only.

5 Principle of the test

The test involves subjecting a test specimen to a constant load until fracture occurs. The time to fracture is measured and recorded.

NOTE An alternative test using a whole pipe welded sample rather that a test specimen cut form the weld is given in Annex B.

The tests are carried out over a range of temperatures and loads, and in a test medium. Only such media shall be used which cause no swelling or degradation of the polymer. Examples of available test media are air, water or solutions of demineralised water with detergents.

Care should be taken to ensure that the condition of the test medium does not influence the results of the test.

The applicability of the long-term tensile welding factor for design purposes requires a minimum creep rupture time for the parent material (t_{tm}). Before determining the long-term welding factor for the materials mentioned in Annex C, a tensile creep test should be carried out on the parent material at one of the test conditions given in Table C.1. The values of creep rupture time should be at least that quoted in Table C.1.

Application standards may prescribe higher values for these rupture times depending upon the semi-finished product and material.

6 Sampling procedures

Welded and unwelded test specimens shall be taken from the same test piece.

NOTE In the case of socket joints, see Annex D.

The test specimens (welded and unwelded) shall be cut perpendicular to the welded joint at least eight hours after welding. For sheets where the extrusion direction is different on either side of the weld, the unwelded test specimens shall be taken from the side of the test piece which has the lowest creep rupture time.

Each test specimen shall be marked in order to identify its original position within the test piece.

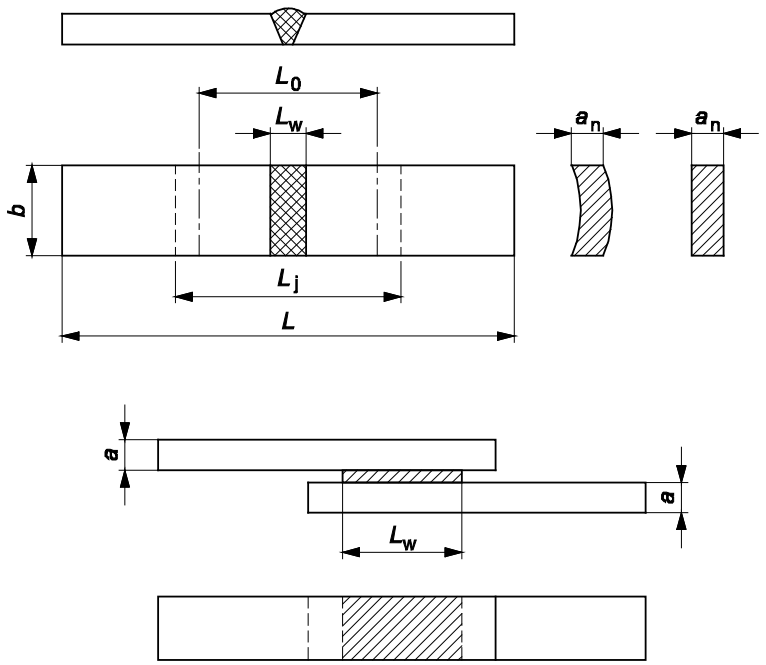
No heat treatment or mechanical straightening operations shall be carried out on the test specimen.

7 Dimensions of test specimens

The dimensions of test specimens according to Figure 1 are given in Table 2 and those according to Figure 2 are given in Table 3.

Profiles can be tested if test specimens are in accordance with the dimensions given in Table 2 or Table 3.

For tubes having nominal outside diameter less than 20 mm, the whole tube shall be tested. In this case, the minimum distance between the clamps shall be 200 mm.



Key

L_j = L_0 + (2xb)

Figure 1 — Type 1 test specimen for flat and tubular assemblies

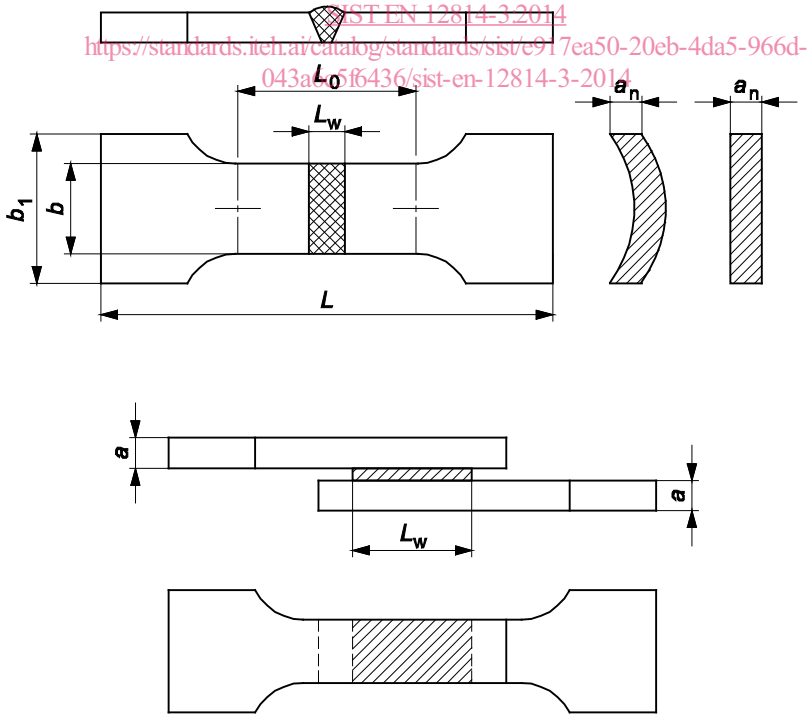


Figure 2 — Type 2 test specimen for flat and tubular assemblies

Table 2 — Dimensions of type 1 test specimens

Dimensions in millimetres

D_n or a_n	b	L_0	L
$20 \le D_n < 50$	$a_n + \frac{D_n}{10}$	80	≥ 120
$50 \le D_n < 100$	$a_n + \frac{D_n}{10}$	120	≥ 170
$D_n \ge 100$ or flat assemblies:			
$a_n \le 10$	15	120	≥ 170
$10 < a_n \le 20$	30	120	≥ 170
$a_n > 20$	1,5 x a_n	3 x a_n + L_w with 120 min	≥ L_0 + 80

Table 3 — Dimensions of type 2 test specimens

Dimensions in millimetres

D_n or a_n	b	min. b_1	L_0	L	r
$20 \le D_n < 50$	$a_n + \frac{D_n}{10}$	b + 10	L_w + 60	≥ 120	60
$50 \le D_n < 100$	$a_n + \frac{D_n}{10}$	b + 10	L_w + 60	≥ 170	60
$D_n \ge 100$ or flat assemblies:					
$a_n \le 10$	10	20	115	≥ 170	60
$10 < a_n \le 20$	30	40	115	≥ 170	60
$a_n > 20$	1,5 x a_n	2,5 x a_n	3 x a_n + L_w with 120 min	≥ L_0 + 80	60

Where the beads are left intact in service, they shall be left intact for the test. Where the beads are removed in service, they shall be removed prior to testing.

The minimum value for b shall be 6 mm. The tolerance for b shall be ± 1 mm. The tolerance for L_0 shall be ± 2 mm.

The variation of b over the length L_0 shall not exceed ± 2 % of the average value of b.

8 Cutting and preparation of test specimens

The tensile creep test specimens shall be cut with parallel sides as shown in Figures 1 and 2. During cutting, heating of the test specimen shall be minimized.

The cutting operation shall not cause any damage to the test specimen.

After cutting, a visual examination of the weld according to EN 13100-1 shall be carried out and recorded.