SLOVENSKI STANDARD
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Neporušitveno preskušanje zvarjenih spojev plastomernih polizdelkov - 4. del: Visokonapetostno preskušanje

Non destructive testing of welded joints of thermoplastics semifinished products - Part 4: High voltage testing

Zerstörungsfreie Prüfung von Schweißverbindungen thermoplastischer Kunststoffe - Teil 4: Hochspannungsprüfung

Essais non destructifs des assemblages soudés sur produits semi-finis en thermoplastiques - Partie 4: Essais à haute tension

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Non destructive testing of welded joints of thermoplastics semifinished products - Part 4: High voltage testing

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Foreword

This document (EN 13100-4:2012) has been prepared by Technical Committee CEN/TC 249 "Platics", 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of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

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 is composed of the following parts:

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

— EN 13100-2, *Non-destructive testing of welded joints in thermoplastics semi-finished products — Part 2: X-ray radiographic testing*;

— EN 13100-3, *Non destructive testing of welded joints in thermoplastics semi-finished products — Part 3: Ultrasonic testing*;

— EN 13100-4, *Non destructive testing of welded joints of thermoplastics semifinished products — Part 4: High voltage testing*.

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1 Scope

This European Standard specifies the equipment and methods for the high voltage testing of butt or overlap welded joints in thermoplastic sheets for locating through-thickness defects only. It applies to new unused constructions only.

2 Terms and definitions

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

2.1
dielectric strength
maximum voltage a material of unit thickness can withstand continuously without failure

3 Symbols and designations

Symbols and designations are given in Table 1.

Table 1 — Symbols and designations

Symbol	Designation	Unit
D_s	Dielectric strength	Vmm^{-1}
V_B	Breakdown voltage	V
d_t	Distance from test electrode to conductor	mm
V_I	Initial test voltage	V
V_A	Actual voltage used for the test	V
V_o	Voltage which causes a spark at a hole in the plastic sheet	V

4 Principle of the test

A high voltage is applied to one side of the joint to be tested using a suitable electrode, the other side of the material needs to be in contact with a conductive substrate which in some cases will need a connection back to the test equipment.

The test shall be carried out with a voltage high enough to jump the gap between the test electrode and a conductor. A defect is indicated by a spark discharge and, depending on the equipment used, a simultaneous optical and / or acoustic signal.

The health and safety aspects (e.g. electric shocks, risks of explosions in flammable atmosphere) together with the environmental impacts (e.g. electromagnetic disturbances) shall be thoroughly considered before operating the equipment.

NOTE Moisture in concrete can make it sufficiently conductive to allow high voltage testing to be used.

5 Equipment types

5.1 General

There are three types of high voltage tester available. The most appropriate type to be used will depend on the type of tests to be carried out and customer requirements.

5.2 High frequency spark tester

5.2.1 Principle

This equipment generates a high frequency AC voltage of up to 100 kV. It is normally mains powered. The output is low power and normally un-stabilised. The output voltage is adjusted by spark length. Defects are normally indicated by visual spark only.

5.2.2 Advantages

— No connection to the substrate required as long as it is metal and has an area 1 000 times larger than the test electrode.

— Higher output voltages, allowing thicker material or longer overlap joints to be tested.

5.2.3 Limitations

— No output voltage meter.

— Fault identified by visual spark only.

— AC mains powered.

5.3 DC Holiday detector

5.3.1 Principle

This equipment generates a DC high voltage of up to 50 kV. It can be mains or battery powered. The output is low power and normally stabilised. The output voltage is indicated on a meter either in the unit or external to it. Defects are indicated by the activation of an optical and/or acoustic signal as well as a visual spark.

5.3.2 Advantages

— The test voltage can be set accurately.

— Can be used on concrete substrates.

5.3.3 Limitations

— Connection to substrate required.

— Can be affected by moisture on the surface of the thermoplastic sheet.

5.4 Pulsed Holiday detector

5.4.1 Principle

This equipment generates a pulsed DC high voltage of up to 50 kV. The pulse rate can be from 30 to 10 000 pulses per second depending on the manufacturer. Pulsed units tend to have higher power output than spark testers or DC holiday detectors. The output voltage can be verified using a crest reading voltmeter. Imperfections are indicated by the activation of an optical and/or acoustic signal as well as a visual spark.

5.4.2 Advantages

— Can work in the presence of a small amount of moisture on the surface.

5.4.3 Limitations

— Connection to substrate required.

— Output voltage harder to verify (special meter required).

— Lower speed of testing dependent on pulse rate.

6 Determination of test voltage

6.1 General

This section is for testers that can be set to a known voltage.

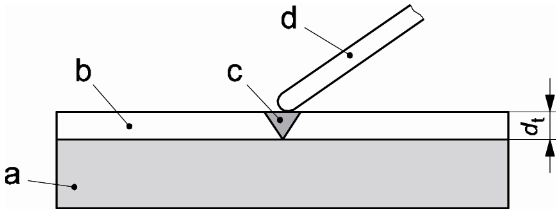
6.2 Butt joints

6.2.1 Test arrangement

For butt joints in thermoplastic sheets with a thickness in the range 1 mm to 30 mm (see Figure 1), the initial test voltage, V_I, is given by:

$$V_I = 250\ (1000\ d_t)^{½} \quad (1)$$

Providing the test electrode is in contact with the upper surface of the sheet and the conductive substrate is in contact with the lower surface of the sheet, d_t is equal to the sheet thickness.



Key

a substrate
b plastic sheet
c weld
d electrode

Figure 1 — Butt joint

However, depending on the dielectric strength of the sheet, V_I can damage the material. The breakdown voltage, V_B, is given by:

$$V_B = D_s \, d_t \tag{2}$$

The value of the breakdown voltage, V_B, for each sheet shall be calculated from Formula (2) using the value of D_s provided by the sheet manufacturer.

If $V_I < V_B$, then the actual test voltage to be used, V_A, shall be equal to V_I.

If $V_I > V_B$, then experimental trials, as described in 6.2.2, shall be carried out to determine V_A.

If the dielectric strength is not known, the output voltage of the tester shall be set to 1.3 V_I. The test electrode shall then be placed on an unwelded test piece of the same material in which the welds are to be examined and the voltage shall be applied for a duration of 1 min. If no fault is made in the sheet then V_A shall be equal to V_I. If the material fails then further experimental trials, as described in 6.2.2, shall be carried out to determine V_A.

6.2.2 Determination of V_A if $V_I > V_B$

A 1 mm diameter perpendicular hole shall be made in an unwelded test piece of the same material in which the welds are to be examined, using a clean drill. The minimum distance from the hole to the edge of the test piece shall be five times the sheet thickness. With the electrode over the hole, the voltage shall be increased until a spark jumps the gap. This voltage, V_o, shall be noted.

Further holes shall be made in the test piece at an angle of 45°. The minimum distance between holes and also between any hole and the edge of the test piece shall again be five times the sheet thickness. The test voltage shall then be increased to $(V_B+V_o)/2$ and, if all of the holes are detected, this shall be used as V_A.

If any of the holes are not detected, the test voltage shall be increased by 10 % and the tests shall be repeated using new holes. Test holes shall only be used once.

6.3 Overlap joints

In overlap joints the distance from the test electrode to the substrate, d_t, can be many times the thickness of the material and the test voltage required could therefore cause the material to break down.

To minimise the test voltage required, a thin un-insulated wire should be placed as close as possible to the inside of the weld. See Figure 2.