



SLOVENSKI STANDARD

SIST EN 13100-2:2005

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Neporušitveno preskušanje zvarjenih spojev plastomernih polizdelkov - 2. del: Rentgensko (radiografsko) preskušanje

Non-destructive testing of welded joints in thermoplastics semi-finished products - Part 2:
X-ray radiographic testing

Zerstörungsfreie Prüfung von Schweißverbindungen thermoplastischer Kunststoffe - Teil
2: Röntgenprüfung

Essais non destructifs des assemblages soudés sur produits semi-finis en
thermoplastiques - Partie 2: Contrôle radiographique par rayons X

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ICS:

25.160.40	Varjeni spoji in vari	Welded joints
83.140.01	Izdelki iz gume in polimernih materialov na splošno	Rubber and plastics products in general

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Non-destructive testing of welded joints in thermoplastics semi-finished products - Part 2: X-ray radiographic testing

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This European Standard was approved by CEN on 14 October 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 13100-2:2004) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

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 May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

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

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EN 13100-2:2004 (E)**1 Scope**

This document specifies fundamental radiographic techniques which enable repeatable results to be obtained economically.

This document applies to the X-ray radiographic examination of heated tool, electrofusion, extrusion and hot gas joints in plastics materials.

It applies to joints in single wall pipes and plates with a range of thicknesses from 5 mm to 100 mm. It only applies to pipes containing air or other gases at the time of X-ray testing.

This document does not specify acceptance levels of the indications.

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.

EN 462-1, *Non-destructive testing — Image quality of radiographs — Part 1: Image quality indicators (wire type) - Determination of image quality value*

EN 462-2, *Non-destructive testing — Image quality of radiographs — Part 2: Image quality indicators (step/hole type) - Determination of image quality value*

EN 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

EN 584-1, *Non destructive testing — Industrial radiographic film — Part 1: Classification of film systems for industrial radiography*

EN 584-2, *Non destructive testing — Industrial radiographic film — Part 2: Control of film processing by means of reference values*

EN 25580, *Non destructive testing — Industrial radiographic illuminators — Minimum requirements (ISO 5580:1985)*

3 Terms and definitions

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

3.1**nominal thickness**

nominal thickness of the parent material

NOTE Manufacturing tolerances are not taken into account.

3.2**penetrated thickness**

thickness of material in the direction of the radiation beam including the thickness of the weld beads on butt fusion joints (if appropriate), or the additional thickness of the socket for electrofusion joints, or the combined thickness of the top and bottom half of the joint for multiple wall techniques

3.3**object-to-film distance**

distance between the radiation side of the test object and the film surface, measured along the central axis of the radiation beam

3.4**source size**

size of the radiation source, e.g. the focal spot size of the X-ray tube

3.5**source-to-film distance**

distance between the radiation source and the film measured in the direction of the beam

3.6**source-to-object distance**

distance between the radiation source and the source side of the test object, measured along the central axis of the radiation beam

3.7**diameter**

nominal outside diameter of the pipe

4 Symbols and abbreviations

Symbols and abbreviations are given in Table 1.

Table 1 — Symbols and abbreviations

Symbols and abbreviations	Designations	Units
b	Object-to-film distance	mm
d	Source size	mm
D_n	Diameter	mm
t	Source-to-object distance	mm
SFD	Source-to-film distance	mm
t	Nominal thickness	mm
w	Penetrated thickness	mm
S	Radiation source	—
F	Film	—
α	Inclination angle	
SDR	D_n/t	—

5 General**5.1 Security Measures**

Local or national or international safety precautions when using ionising radiation shall be strictly applied.

WARNING NOTICE - Exposure of any part of the human body to X-rays can be highly injurious to health. Wherever X-ray equipment is in use, appropriate legal requirements shall be applied.

5.2 Surface preparation and stage of manufacture

Prior to radiography the joint shall be cleaned to remove all traces of dirt etc. from the component surface, which might later cause difficulty in detecting defects.

In the case of heated tool butt welded pipes, the external weld bead shall be removed prior to radiography.

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5.3 Location of the weld in the radiograph

Where the weld is not likely to be clearly visible on the radiograph, high-density markers (e.g. lead) shall be placed on either side of the weld before testing.

5.4 Identification of radiographs

Symbols (normally lead markers) shall be affixed to each section of the object being radiographed. The images of these symbols shall appear in the radiograph outside the region of interest and shall ensure unambiguous identification of the section.

5.5 Marking

Permanent markings on the object to be examined shall be made in order to accurately locate the position of each radiograph.

Where the nature of the material and/or its service conditions do not permit permanent marking, the location of each radiograph may be recorded by means of accurate sketches.

5.6 Overlap of films

When radiographing an area with two or more separate films, the films shall overlap sufficiently to ensure that the complete region of interest is radiographed. This shall be verified by a high-density marker on the surface of the object, which will appear on each film.

5.7 Types and position of image quality indicators (IQI)

The quality of image shall be verified by use of image quality indicator(s) (IQI) in accordance with EN 462-1 or EN 462-2. The IQI(s) shall be made from the same material as the inspected material or a material with a similar absorption with a tolerance of $\pm 10\%$ in the absorption coefficient. In accordance with EN 462-1 or EN 462-2 the applied IQI(s) shall have the inscription with the name of the document, the number of the thickest wire or the first step hole and the material. For plastic materials, this requires the name of the material (e.g.: PE- polyethylene, PP- polypropylene, PVC- polyvinylchloride, etc.) and the materials density given in g/cm^3 with at least two significant digits.

The IQI used shall be placed preferably on the source side of the test object at the centre of the area of interest on the parent material beside the weld. The IQI shall be in close contact with the surface of the object.

It shall be located in a section of uniform thickness characterised by a uniform optical density on the film.

According to the IQI type used, two cases shall be considered.

- a) When using a wire IQI, the wires shall be directed perpendicular to the weld and its location shall ensure that at least 10 mm of the wire length will show in a section of uniform optical density, which is normally in the parent material adjacent to the weld. At exposures in accordance with Figures 3 and 4 the IQI should not be projected into the image of the weld.
- b) When using a step/hole IQI, it shall be placed in such a way that the hole number required is placed close to the weld.

At exposures in accordance with Figures 3 and 4 the IQI may be placed on the film side. In this case reference shall be made to Tables A.5 and A.6 given in Annex A.

Where the IQIs are placed at the film side, the lead letter 'F' shall be placed near the IQI and it shall be noted in the test report.

If steps have been taken to guarantee that radiographs of similar test objects and regions are produced with identical exposure and processing techniques, and no differences in the image quality value are likely, the image

quality need not be verified for every radiograph, the extent of image quality verification being subject to agreement between the contracting parties.

For panoramic exposures of pipes (see Figure 2) with diameter 200 mm and above, at least three IQIs shall be placed equally spaced around the circumference. The film(s) showing IQI images are then considered representative for the whole circumference.

5.8 Evaluation of image quality

The films shall be viewed in accordance with EN 25580.

From the examination of the image of the IQI on the radiograph, the number of the smallest wire or hole, which shall be discerned, shall be determined. The image of a wire shall be accepted if a continuous length of at least 10 mm is clearly visible in a section of uniform optical density. In the case of the step/hole type IQI, if there are two holes of the same diameter, both shall be discernible in order that the step is considered as visible.

The image quality obtained shall be indicated on the examination report of the radiographic examination. In each case, the type of indicator used shall be clearly stated, as shown on the IQI.

5.9 Minimum image quality values

Tables A.1 to A.6 in Annex A show the minimum image quality values for plastics materials.

5.10 Personnel qualification

Personnel performing non-destructive examination in accordance with this document shall be qualified in accordance with the relevant document, e.g. EN 473.

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6 Recommended techniques for making radiographs

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6.1 Test arrangements

Normally radiographic techniques in accordance with Figures 1 to 9 shall be used.

In the case of heated tool butt welded pipes, the external weld bead shall be removed prior to radiography.

For test arrangements in accordance with Figures 3, 5 and 6, the inclination of the beam shall be kept as small as possible, but sufficient to prevent superimposition of the two images. The source-to-object distance, f , should be kept as small as possible, in accordance with 6.5. For Figures 5 and 6, the IQI shall be placed close to the film with a lead letter 'F'.

The elliptical technique (double wall/double image) in accordance with Figure 3 shall not be used for $D_n > 100$ mm and $t > 8$ mm.

Other radiographic techniques may be specified when appropriate, e.g. for reasons such as the geometry of the piece or differences in material thickness.

Annex B gives the minimum number of radiographs necessary to obtain an acceptable radiographic coverage of a butt weld in pipe of $D_n > 100$ mm.