SLOVENSKI STANDARD
oSIST prEN 16407-1:2012

01-maj-2012

Neporušitveno preskušanje - Radiografski pregled korozije in nanosov v ceveh z rentgenskimi in gama žarki - 1. del: Tangencialni radiografski pregled

Non-destructive testing - Radiographic inspection of corrosion and deposits in pipes by X - and gamma rays - Part 1: Tangential radiographic inspection

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung auf Korrosion und Ablagerungen in Rohren mit Röntgen- und Gammastrahlen - Teil 1: Tangentielle Durchstrahlungsprüfung

Ta slovenski standard je istoveten z: **prEN 16407-1**

ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing
23.040.01	Deli cevovodov in cevovodi na splošno	Pipeline components and pipelines in general

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Non-destructive testing - Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays - Part 1: Tangential radiographic inspection

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung auf Korrosion und Ablagerungen in Rohren mit Röntgen- und Gammastrahlen - Teil 1: Tangentielle Durchstrahlungsprüfung

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Foreword

This document (prEN 16407-1:2012) has been prepared by Technical Committee CEN/TC 138 “Non-destructive testing”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

prEN 16407 consists of the following parts, under the general title *Non-destructive testing — Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays* :

— Part 1: Tangential radiographic inspection;

— Part 2: Double Wall radiographic inspection.

1 Scope

This part specifies fundamental techniques of film and digital radiography with the object of enabling satisfactory and repeatable results to be obtained economically. The techniques are based on generally recognized practice and fundamental theory of the subject.

This standard applies to the radiographic examination of pipes in metallic materials for service induced flaws such as corrosion pitting, generalised corrosion and erosion. Besides its conventional meaning, "pipe" as used in this standard should be understood to cover other cylindrical bodies such as tubes, penstocks, boiler drums and pressure vessels.

Weld inspection for typical welding process induced flaws is not covered, but weld inspection is included for corrosion/erosion type flaws.

The pipes may be insulated or not, and can be assessed where loss of material due, for example, to corrosion or erosion is suspected either internally or externally.

This Part of this standard covers the tangential inspection technique for detection and through-wall sizing of wall loss, including (a) with the source on the pipe centre line, and (b) with the source offset from it by the pipe radius.

Part 2 of this standard covers double wall radiography, and note that the double wall double image technique is often combined with tangential radiography with the source on the pipe centre line.

This standard applies to tangential radiographic inspection using industrial radiographic film techniques, computed digital radiography (CR) and digital detector arrays (DDA).

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 12679:1999, *Non-destructive testing — Determination of the size of industrial radiographic sources — Radiographic method*

EN 14784-1, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

EN 14096-2:2003, *Non-destructive testing - Qualification of radiographic film digitisation systems - Part 2: Minimum requirements*

EN 25580:1992, *Non-destructive testing - Industrial radiographic illuminators - Minimum requirements*

prEN ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

EN ISO 11699-1, *Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography*

EN ISO 11699-2, *Non-destructive testing - Industrial radiographic film - Part 2: Control of film processing by means of reference*

FprEN ISO 17636–1:2012, *Non-destructive testing of welds — Radiographic examination of welded joints — Part 1: X- and gamma-ray techniques with film*

prEN ISO 19232–5:2011, *Non-destructive testing — Image quality of radiographs — Part 5: Image quality indicators (duplex wire type) - Determination of image unsharpness value*

3 Terms and definitions

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

3.1
maximum penetrated thickness
w_{max}
maximum thickness of material for a pipe which occurs for a tangent to the inner pipe surface

3.2
nominal thickness
t
nominal thickness of the parent material only where manufacturing tolerances do not have to be taken into account

3.3
object-to-detector distance
b
distance between the radiation side of the test object and the detector surface measured along the central axis of the radiation beam

3.4
outside diameter
D_e
nominal outside diameter of the pipe

3.5
penetrated thickness
w
thickness of material in the direction of the radiation beam calculated on the basis of the nominal thickness

Note 1 to entry: For tangential radiographic inspection of a pipe, the minimum value for w is twice the pipe wall thickness. For multiple wall techniques the penetrated thickness is calculated from the nominal thickness.

3.6
pipe centre to detector distance
PDD
distance between the pipe centre and the detector

3.7
source size
d
size of the radiation source

[SOURCE: EN 12679:1999, 2.1]

3.8
source-to-detector distance
SDD
distance between the source of radiation and the detector measured in the direction of the beam

3.9
source-to-pipe centre distance
SPD
distance between the source of radiation and the pipe centre (pipe axis) measured in the direction of the beam

3.10
source-to-object distance
f
distance between the source of radiation and the source side of the test object measured along the central axis of the radiation beam

3.11
total effective penetrated thickness
W_{tot}
total equivalent thickness of metallic material in the direction of the radiation beam calculated on the basis of the nominal thickness, with allowance for any liquid or gaseous product present in the pipe

3.12
actual wall thickness
WT
actual wall thickness of the pipe

3.13
measured wall thickness
WT'
measured wall thickness of the pipe on the radiograph or digital image

3.14
pixel size
geometrical centre-to-centre distance between adjacent pixels in a row (horizontal pitch) or column (vertical pitch) of the scanned image

[SOURCE: EN 14096-2:2003]

4 Classification of radiographic techniques

The tangential radiographic techniques are divided into two classes:

— basic technique TA

— improved technique TB

The basic techniques, TA, are intended for tangential radiography of generalised wall loss, such as that due to erosion or large scale corrosion.

The improved techniques, TB, should be used for the more demanding tangential radiography of localised corrosion pitting flaws, which require higher sensitivity for detection and sizing.

Further technique improvements beyond TB are possible and may be agreed between the contracting parties by specification of all appropriate test parameters.

The choice of radiographic technique shall be agreed between the concerned parties.

5 General

5.1 Protection against ionizing radiation

WARNING — Exposure of any part of the human body to X-rays or gamma-rays can be highly injurious to health. Wherever X-ray equipment or radioactive sources are in use, appropriate legal requirements must be applied. Local or national or international safety precautions when using ionizing radiation shall be strictly applied.

5.2 Personnel qualification

Testing shall be carried out by proficient, suitably trained and qualified personnel and, where applicable, shall be supervised by competent personnel nominated by the employer or, by delegation of the employer, the inspection company in charge of testing. To demonstrate appropriate qualification it is recommended that personnel be certified according to prEN ISO 9712 or an equivalent formalised system. Operating authorisation for qualified person shall be issued by the employer in accordance with a written procedure.

NDT operations, unless otherwise agreed, shall be authorised by a competent and qualified NDT supervisory individual (Level 3 or equivalent) approved by the employer.

The personnel shall prove additional training and qualification in digital industrial radiology if digital detectors are being used.

5.3 Surface preparation

In general, surface preparation is not necessary, but where surface imperfections or coatings might cause difficulty in detecting flaws or significant errors in thickness measurements, the surface shall be ground smooth or the coatings shall be removed.

5.4 Identification of radiographs

Symbols 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 where possible 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 may be recorded by means of accurate sketches.

5.6 Overlap of films or digital images

When radiographing an area with two or more films or separate detectors, the films or detectors 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 or detector. If the radiographs will be taken sequentially, the high density marker shall be visible on each of the radiographs.

5.7 Types and positions of image quality indicators (IQI)

5.7.1 Single wire or step hole IQIs

For tangential radiography, single wire or step hole IQIs are not applicable.

5.7.2 Duplex wire IQI (digital radiographs)

If applicable, IQIs in accordance with prEN ISO 19232-5:2011 should be used for measurement of the basic spatial resolution of the CR/DDA system (see 7.1.2 and Annex A). The duplex wire IQI shall be placed adjacent to the imaging plate or detector array and positioned a few degrees tilted (2° – 5°) to the digital rows or columns of the digital image.

6 Recommended techniques for making radiographs

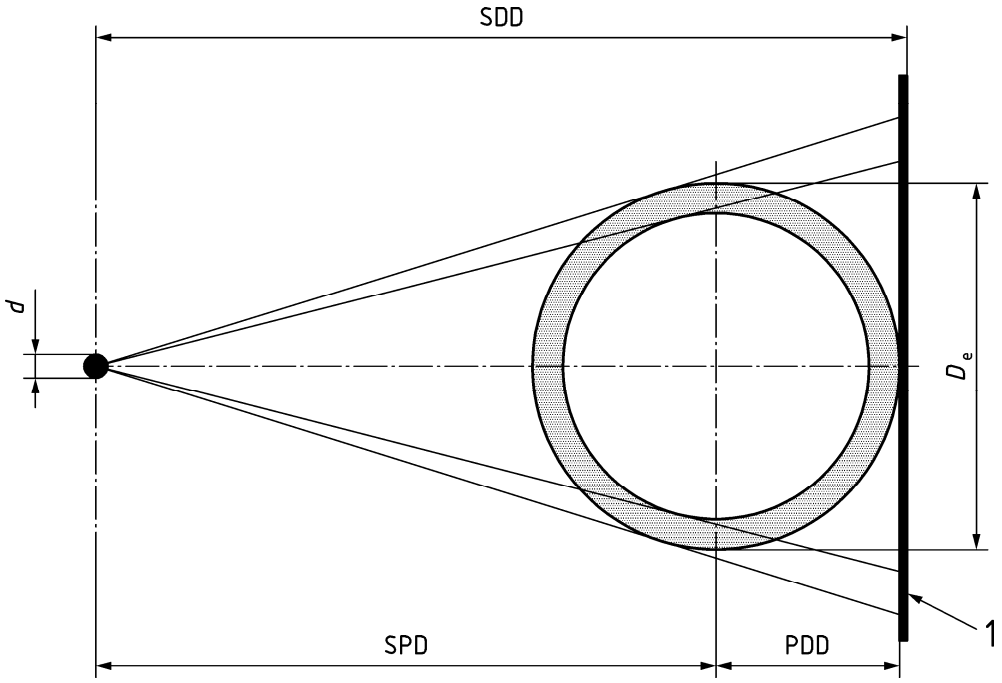
6.1 Test arrangements

6.1.1 General

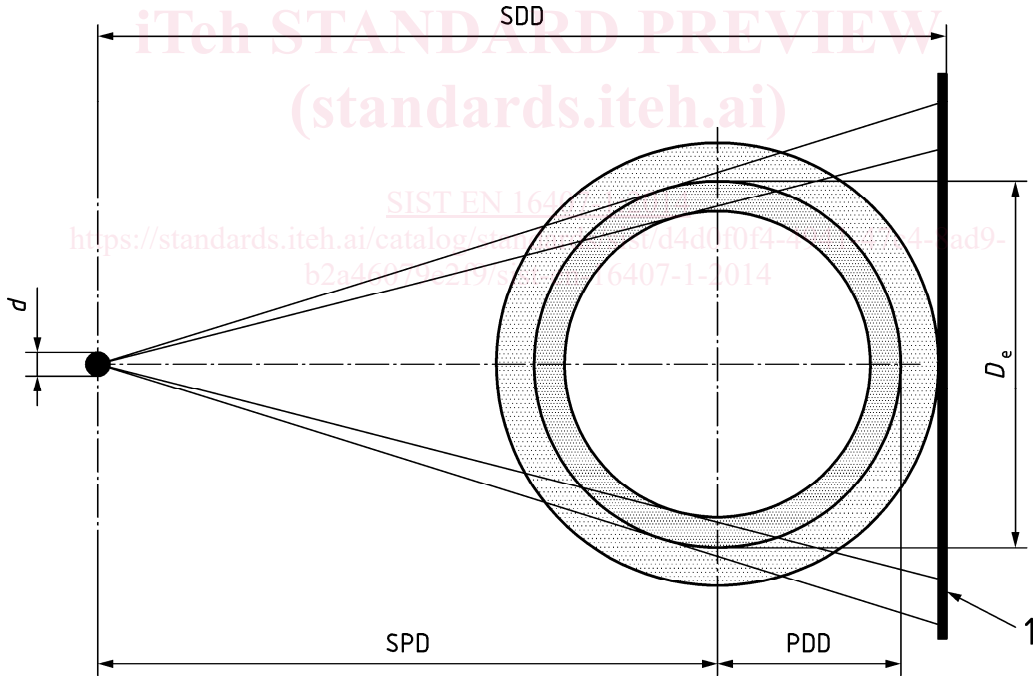
Normally radiographic techniques in accordance with 6.1.2 and 6.1.3 shall be used. For both techniques, the film or digital detector shall be placed as close to the pipe as possible.

6.1.2 Radiation source located on the pipe centre line

For this arrangement the source is located in front of the pipe and with the film/detector at the opposite side, as shown in Figure 1. The pipe can be non insulated (Figure 1a)) or insulated (Figure 1b)).



a) non insulated pipe



b) insulated pipe

Key

1 film/detector

Figure 1 — Test arrangement and distances for tangential radiography with the source on the pipe centre line

Note that the wall loss can be located on either the inner diameter or outer diameter surface of the pipe.