

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

BS EN 16407-2:2014



BSI Standards Publication

Non-destructive testing — Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays

Part 2: Double wall radiographic inspection

bsi.

...making excellence a habit.™

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

This British Standard is the UK implementation of EN 16407-2:2014.

The UK participation in its preparation was entrusted to Technical Committee WEE/46, Non-destructive testing.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2014. Published by BSI Standards Limited 2014

ISBN 978 0 580 77931 2

ICS 19.100; 23.040.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2014.

Amendments issued since publication

Date	Text affected
------	---------------

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

EUROPÄISCHE NORM

January 2014

ICS 19.100; 23.040.01

English Version

Non-destructive testing - Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays - Part 2: Double wall radiographic inspection

Essais non destructifs - Examen radiographique de la corrosion et des dépôts dans les canalisations, par rayons X et rayons gamma - Partie 2: Examen radiographique double paroi

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung auf Korrosion und Ablagerungen in Röhren mit Röntgen- und Gammastrahlen - Teil 2: Doppelwand Durchstrahlungsprüfung

This European Standard was approved by CEN on 26 October 2013.

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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

Contents

Page

Foreword.....	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	6
4 Classification of radiographic techniques	8
5 General.....	9
5.1 Protection against ionizing radiation.....	9
5.2 Personnel qualification	9
5.3 Identification of radiographs	9
5.4 Marking	9
5.5 Overlap of films or digital images	9
5.6 Types and positions of image quality indicators (IQI).....	9
5.6.1 Single wire IQI	9
5.6.2 Duplex wire IQI (digital radiographs).....	10
6 Recommended techniques for making radiographs.....	10
6.1 Test arrangements.....	10
6.1.1 General.....	10
6.1.2 Double wall single image (DWSI)	10
6.1.3 Double wall double image (DWDI).....	12
6.1.4 Alignment of beam and film/detector	14
6.2 Choice of radiation source	14
6.3 Film systems and screens	15
6.4 Screens and shielding for imaging plates (computed radiography only)	17
6.5 Reduction of scattered radiation.....	18
6.5.1 Filters and collimators	18
6.5.2 Interception of back scattered radiation	19
6.6 Source-to-detector distance	19
6.6.1 Double wall single image	19
6.6.2 Double wall double image.....	20
6.7 Axial coverage and overlap	20
6.8 Circumference coverage.....	21
6.8.1 General.....	21
6.8.2 DWSI.....	21
6.8.3 DWDI	22
6.9 Selection of digital radiographic equipment.....	22
6.9.1 General.....	22
6.9.2 CR systems	22
6.9.3 DDA systems	22
7 Radiograph/digital image sensitivity, quality and evaluation	22
7.1 Minimum image quality values.....	22
7.1.1 Wire image quality indicators.....	22
7.1.2 Duplex wire IQIs (digital radiographs).....	23
7.1.3 Minimum normalized signal to noise ratio (digital radiographs).....	23
7.2 Density of film radiographs	23
7.3 Film processing	24
7.4 Film viewing conditions	24

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

8	Measurement of differences in penetrated thickness	24
8.1	Principle of technique	24
8.2	Measurement of attenuation coefficient	25
8.3	Source and detector positioning	25
8.4	Image grey level profiles.....	25
8.5	Validation.....	25
8.6	Key Points	25
9	Digital image recording, storage, processing and viewing	26
9.1	Scan and read out of image.....	26
9.2	Calibration of DDAs.....	26
9.3	Bad pixel interpolation.....	26
9.4	Image processing	26
9.5	Digital image recording and storage	26
9.6	Monitor viewing conditions	27
10	Test report.....	27
	Annex A (normative) Minimum image quality values	29
	Annex B (informative) Penetrated thickness measurements from image grey levels.....	31
	Annex C (normative) Determination of basic spatial resolution	33
	Bibliography.....	36

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

Foreword

This document (EN 16407-2:2014) has been prepared by Technical Committee CEN/TC 138 "Non-destructive testing", the secretariat of which is held by AFNOR.

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 July 2014, and conflicting national standards shall be withdrawn at the latest by July 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.

EN 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.*

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.

This is a preview of "BS EN 16407-2:2014". [Click here to purchase the full version from the ANSI store.](#)

1 Scope

This European Standard 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 European Standard applies to the radiographic examination of pipes in metallic materials for service induced flaws such as corrosion pitting, generalized 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 EN 16407 covers double wall inspection techniques for detection of wall loss, including double wall single image (DWSI) and double wall double image (DWDI).

Note that the DWDI technique described in this part of EN 16407 is often combined with the tangential technique covered in EN 16407-1.

This European Standard applies to in-service double wall 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 14784-1, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

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

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

EN ISO 17636-2:2013, *Non-destructive testing of welds — Radiographic testing — Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2:2013)*

EN ISO 19232-1, *Non-destructive testing — Image quality of radiographs — Part 1: Determination of the image quality value using wire-type image quality indicators (ISO 19232-1)*

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