

Non-destructive testing - Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays - Part 2: Double wall radiographic inspection (ISO 20769-2:2018)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 20769-2:2018 sisaldab Euroopa standardi EN ISO 20769-2:2018 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 20769-2:2018 consists of the English text of the European standard EN ISO 20769-2:2018.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 31.10.2018.	Date of Availability of the European standard is 31.10.2018.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 19.100

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:

Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Non-destructive testing - Radiographic inspection of
corrosion and deposits in pipes by X- and gamma rays -
Part 2: Double wall radiographic inspection (ISO 20769-
2:2018)

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 (ISO 20769-2:2018)

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung
auf Korrosion und Ablagerungen in Rohren mit
Röntgen- und Gammastrahlen - Teil 2: Doppelwand-
Durchstrahlungsprüfung (ISO 20769-2:2018)

This European Standard was approved by CEN on 9 August 2018.

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, Serbia, 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: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 20769-2:2018) has been prepared by Technical Committee ISO/TC 135 "Non-destructive testing" in collaboration with 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 April 2019, and conflicting national standards shall be withdrawn at the latest by April 2019.

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

This document supersedes EN 16407-2:2014.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 20769-2:2018 has been approved by CEN as EN ISO 20769-2:2018 without any modification.

Contents

Page

Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Classification of radiographic techniques	3
5 General	3
5.1 Protection against ionizing radiation	3
5.2 Personnel qualification	4
5.3 Identification of radiographs	4
5.4 Marking	4
5.5 Overlap of films or digital images	4
5.6 Types and positions of image quality indicators (IQI)	4
5.6.1 Single wire IQI	4
5.6.2 Duplex wire IQI (digital radiographs)	5
6 Recommended techniques for making radiographs	5
6.1 Test arrangements	5
6.1.1 General	5
6.1.2 Double wall single image (DWSI)	5
6.1.3 Double wall double image (DWDI)	7
6.1.4 Alignment of beam and film/detector	9
6.2 Choice of radiation source	9
6.3 Film systems and screens	10
6.4 Screens and shielding for imaging plates (computed radiography only)	11
6.5 Reduction of scattered radiation	13
6.5.1 Filters and collimators	13
6.5.2 Interception of back scattered radiation	13
6.6 Source-to-detector distance	13
6.6.1 Double wall single image	13
6.6.2 Double wall double image	14
6.7 Axial coverage and overlap	14
6.8 Circumference coverage	15
6.8.1 General	15
6.8.2 DWSI	16
6.8.3 DWDI	16
6.9 Selection of digital radiographic equipment	16
6.9.1 General	16
6.9.2 CR systems	17
6.9.3 DDA systems	17
7 Radiograph/digital image sensitivity, quality and evaluation	17
7.1 Minimum image quality values	17
7.1.1 Wire image quality indicators	17
7.1.2 Duplex wire IQIs (digital radiographs)	17
7.1.3 Minimum normalized signal to noise ratio (digital radiographs)	17
7.2 Density of film radiographs	18
7.3 Film processing	18
7.4 Film viewing conditions	18
8 Measurement of differences in penetrated thickness	18
8.1 Principle of technique	18
8.2 Measurement of attenuation coefficient	19
8.3 Source and detector positioning	19
8.4 Image grey level profiles	19
8.5 Validation	19

8.6	Key points.....	20
9	Digital image recording, storage, processing and viewing.....	20
9.1	Scan and read out of image.....	20
9.2	Calibration of DDAs.....	20
9.3	Bad pixel interpolation.....	20
9.4	Image processing.....	21
9.5	Digital image recording and storage.....	21
9.6	Monitor viewing conditions.....	21
10	Test report.....	21
Annex A (normative)	Minimum image quality values.....	23
Annex B (normative)	Penetrated thickness measurements from image grey levels.....	25
Annex C (normative)	Determination of basic spatial resolution.....	27
Bibliography		30

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 135 *Non-destructive testing*, Subcommittee SC 5 *Radiographic testing*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 20769 series can be found on the ISO website.

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

Part 2:

Double wall radiographic inspection

1 Scope

This document 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 document 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 document is 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 can 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 document 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 document is often combined with the tangential technique covered in ISO 20769-1.

This document 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 are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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

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

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

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

ISO 20769-1, *Non-destructive testing of welds — Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays — Part 1: Tangential radiographic inspection*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20769-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1
digital detector array system
DDA system
electronic device converting ionizing or penetrating radiation into a discrete array of analogue signals which are subsequently digitized and transferred to a computer for display as a digital image corresponding to the radiologic energy pattern imparted upon the input region of the device

3.2
double wall double image technique
DWDI
technique where the radiation source is located outside and away from the pipe, with the detector on the opposite side of the pipe and where the radiograph shows details from both the pipe walls on the detector and source sides of the pipe

Note 1 to entry: See [Figure 3](#).

3.3
double wall single image technique
DWSI
technique where the radiation source is located outside the pipe and close to the pipe wall, with the detector on the opposite side of the pipe and where the radiograph shows only detail from the pipe wall on the detector side

Note 1 to entry: See [Figure 1](#).

3.4
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

3.5
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 double wall radiographic inspection of a pipe, the minimum value for *w* is twice the pipe wall thickness. For multiple wall techniques (pipes in pipe or liners), the penetrated thickness is calculated from the nominal wall thicknesses *t*.