SLOVENSKI STANDARD
SIST EN 12681-1:2018

01-februar-2018

Nadomešča:
SIST EN 12681:2003

Livarstvo - Radiografsko preskušanje - 1. del: Filmske tehnike

Founding - Radiographic testing - Part 1: Film techniques

Gießereiwesen - Durchstrahlungsprüfung - Teil 1: Filmtechniken

Fonderie - Contrôle par radiographie - Partie 1 : Techniques à l'aide de films

Ta slovenski standard je istoveten z: EN 12681-1:2017

ICS:

77.040.20	Neporušitveno preskušanje kovin	Non-destructive testing of metals

SIST EN 12681-1:2018 **en,fr,de**

EUROPEAN STANDARD

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English Version

Founding - Radiographic testing - Part 1: Film techniques

Fonderie - Contrôle par radiographie - Partie 1 : Techniques à l'aide de films

Gießereiwesen - Durchstrahlungsprüfung - Teil 1: Filmtechniken

This European Standard was approved by CEN on 16 July 2017.

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

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European foreword

This document (EN 12681-1:2017) has been prepared by Technical Committee CEN/TC 190 “Foundry technology”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

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 12681:2003.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 10 “Testing for inner discontinuities”:

— to revise EN 12681:2003 into EN 12681-1, *Founding — Radiographic testing — Part 1: Film techniques*;

— and to prepare a further standard EN 12681-2, *Founding — Radiographic testing — Part 2: Techniques with digital detectors*.

Annex G covers the significant technical changes between this European Standard and EN 12681:2003.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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.

Introduction

Radiography can be used to detect internal discontinuities in a casting. The discontinuities can be gas holes, non-metallic inclusions, shrinkage, cracks, inserts or chills or inclusions that have lower or higher densities than the parent metal. This European Standard gives acceptance criteria through severity levels.

1 Scope

This European Standard gives specific procedures for industrial X-ray and gamma radiography for discontinuity detection purposes, using NDT (Non-destructive testing) film techniques. This part of EN 12681 specifies the requirements for film radiographic testing of castings.

Films after exposure and processing become radiographs with different area of optical density. Radiographs are viewed and evaluated using industrial radiographic illuminators.

This part of EN 12681 specifies the recommended procedure for the choice of operating conditions and radiographic practice.

These procedures are applicable to castings produced by any casting process, especially for steel, cast iron, aluminium, cobalt, copper, magnesium, nickel, titanium, zinc and any alloys of them.

NOTE This European Standard considers EN ISO 5579.

This part of this European Standard does not apply to:

— radiographic testing of castings for aerospace applications (see prEN 2002-21);

— radiographic testing of welded joints (see EN ISO 17636-1);

— radiography with digital detectors (see EN 12681-2);

— radioscopic testing (see EN 13068, all parts).

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 12543, *Non-destructive testing — Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing (all parts)*

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

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

EN ISO 5579:2013, *Non-destructive testing - Radiographic testing of metallic materials using film and X- or gamma rays - Basic rules (ISO 5579:2013)*

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 11699-1, *Non-destructive testing - Industrial radiographic film - 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 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 19232-2, *Non-destructive testing - Image quality of radiographs - Part 2: Determination of the image quality value using step/hole-type image quality indicators (ISO 19232-2)*

ISO 5576, *Non-destructive testing — Industrial X-ray and gamma-ray radiology — Vocabulary*

ASTM E 1320:2010, *Reference Radiographs for Titanium Castings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5576, EN ISO 5579 and the following apply.

3.1
wall thickness
t
thickness as measured on the casting

3.2
nominal wall thickness
t_n
thickness as specified on the drawing

3.3
penetrated thickness
w
thickness of material in the direction of the radiation beam calculated on the basis of the real thicknesses of all penetrated walls

3.4
source size
d
size of the radiation source or focal spot size

[SOURCE: EN ISO 5579:2013, definition 3.4]

3.5
object-to-film distance
b
largest (maximum) distance between the source side of the radiographed part of the test object and the film surface measured along the central axis of the radiation beam

3.6
source-to-object distance
f
distance between the source of radiation and the source side of the test object, most distant from the film, measured along the central axis of the radiation beam

3.7
source-to-film distance
SFD
distance between the source of radiation and the film measured in the direction of the beam

Note 1 to entry: SFD = $f + b$

where

f source-to-object distance;

b object-to-film distance.

[SOURCE: EN ISO 5579:2013, definition 3.5, modified – description in words presented as formula]

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Table 1 apply.

Table 1 — Symbols and abbreviations

Symbol or abbreviation	Term	Clause, Figure, Annex
b	object-to-film distance	3.5
d	source size	3.4
D	optical density of film	Clause 12 14.2 Figure 16 Figure 15
f	source-to-object distance	3.6
F	Film	Figure 1
IQI	image quality indicator	Clause 16 Annex A
S	source of radiation	Figure 1
SFD	source-to film-distance	3.7
t	wall thickness	3.1 Figure 1
t_n	nominal wall thickness	3.2 Annexes B to F
w	penetrated thickness	3.3

5 Classification of radiographic techniques

The radiographic techniques are divided into two classes:

— Class A: basic techniques;

— Class B: improved techniques.

It is recommended to perform the testing according to class A, if not otherwise specified in the order. Class B techniques will be used when class A might be insufficiently sensitive.

If, for technical or industrial reasons, it is not possible to meet one of the conditions specified for class B, such as the type of radiation source or the source-to-object distance *f*, it may be agreed by contracting parties that the condition selected may be what is specified for class A. In film radiography the loss of sensitivity shall be compensated by an increase of minimum optical density to 3,0 or by selection of a two class better film system. The other conditions for class B remain unchanged, especially the image quality achieved. Because of the better sensitivity compared to class A, the test specimen may be regarded as being examined to class B. This does not apply if the special SFD reductions as specified in Clause 11 for test arrangements Figure 3 and Figure 4 are used.

6 General preparations and requirements

6.1 General preparations

6.1.1 Protection against ionizing radiation

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

6.1.2 Surface preparation and stage of manufacture

In general, surface preparation is not necessary, but where surface imperfections can cause difficulty in detecting discontinuities, the surface shall be ground smooth.

Unless otherwise specified radiography shall be carried out after the final stage of manufacture, e.g. after grinding or heat treatment.

NOTE For some aluminium and magnesium alloy castings, radiography can be carried out before heat treatment.

6.2 Agreements

Castings with a complex geometry can include areas which cannot be tested by radiography or can only be partly tested. Such areas shall be identified before starting the radiographic testing. Areas which cannot be tested by radiography shall be noted by all contracting parties and be marked on the film position plan.

The following items shall be agreed between the contracting parties by the time of acceptance of the order:

a) manufacturing stage at which castings are to be tested;

b) extent of radiographic testing;

c) test areas;

d) surface condition;

e) testing class;

f) information about the film position plan;

g) marking of test areas on the casting;

h) image quality;

i) marking of the radiographs;

j) acceptance criteria;

k) any additional items;

l) any special requirements.

6.3 Personnel qualification

Unless otherwise agreed, testing shall be performed by personnel qualified in accordance with EN ISO 9712 or equivalent to an appropriate level in the relevant industrial sector.

7 Test arrangements

7.1 General

The test arrangements to be used shall be in accordance with:

— Figures 1 to 4: for single wall radiography;

— Figures 5 to 7: for double wall radiography;

— Figures 8 to 12: for test areas of complex section.

NOTE For an explanation of the symbols in the figures, see Table 1.

If these arrangements are not applicable, other arrangements may be used.

7.2 Single wall radiography of plane areas

The test arrangement for single wall radiography of plane areas shall be in accordance with Figure 1.

7.3 Single wall radiography of curved areas

The test arrangement for single wall radiography of curved areas shall be in accordance with either Figures 2, 3 or 4.

NOTE Rigid cassettes can be used if the corresponding increase of b is considered for the calculation of the distance f between the source and source side of the test object (see Clause 11).

7.4 Double wall radiography of plane and curved areas

The test arrangement for double wall radiography of plane and curved areas shall be in accordance with either Figures 5, 6 or 7.

In the case of test arrangements according to Figure 5, the distance of the source from the surface of the test area shall be minimized provided that the requirements of IQI are met.

In the case of test arrangements according to Figures 6 and 7, the discontinuities shall be classified with reference to the single wall thickness. In the case of different wall thicknesses the reference shall be the smaller one.

Double wall radiography shall be used, as an overview technique according to Figure 7, if the geometrical conditions make other test arrangements difficult to apply or if there is a better sensitivity for detecting discontinuities by using this technique. It shall be ensured that unacceptable discontinuities are detected with sufficient certainty. The required image quality shall be met.

7.5 Choice of test arrangements for complex geometries

Unless otherwise agreed, the test arrangements for complex geometry areas shall be in accordance with Figures 8 to 12 (as appropriate).

7.6 Acceptable test area dimensions

The test area to be captured with one radiographic film should be limited in a way that the required optical density according to Clause 12, Table 5 is met in the region of interest.

In addition to the requirements above, the angle of incident radiation in the entire region of interest shall not exceed 30 °.

NOTE This value can be larger, if special orientations of discontinuities can be detected in this way or if it is the only way to test areas otherwise impossible to test.

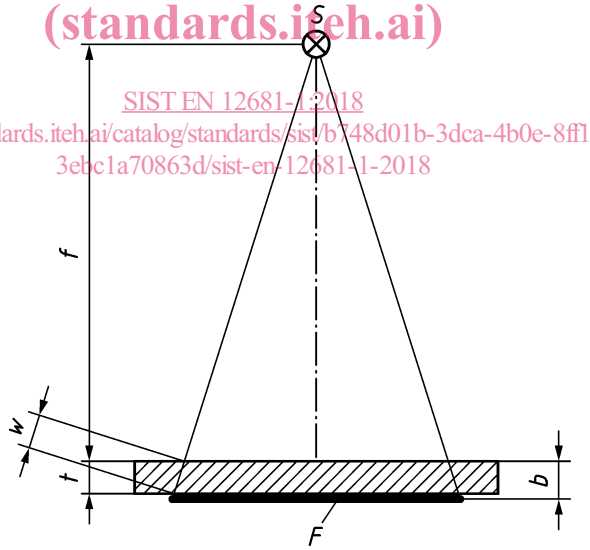
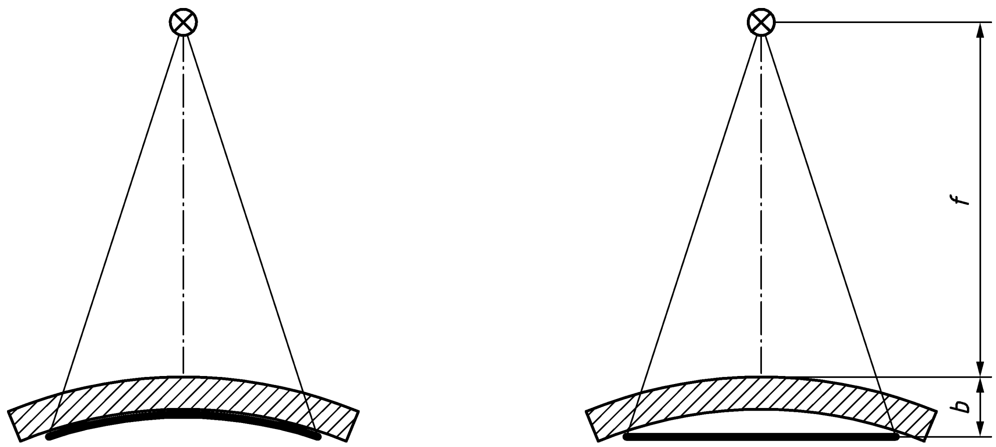


Figure 1 — Test arrangement for single wall radiography of plane areas



a) with flexible cassette   b) with rigid cassette

Figure 2 — Test arrangement for single wall radiography of curved areas with the source on the convex side and the film on the concave side of the test area

a) with flexible cassette   b) with rigid cassette

Figure 3 — Test arrangement for single wall radiography of curved areas with eccentric positioning of the source on the concave side and the film on the convex side of the test area

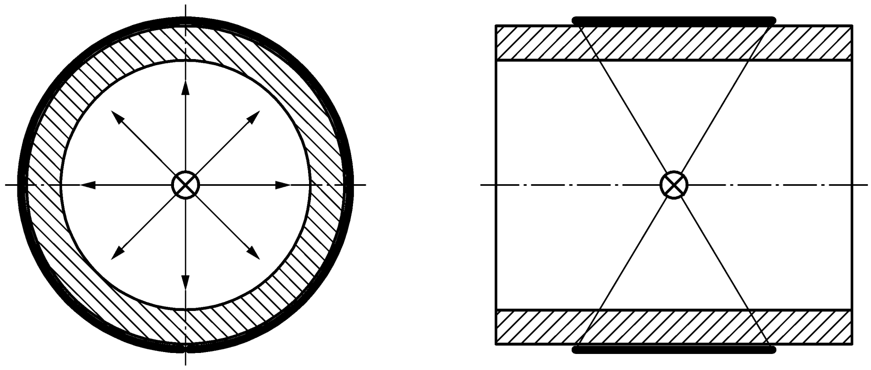


Figure 4 — Test arrangement for single wall radiography of curved areas with central positioning of the source on the concave side and film on the convex side of the test area

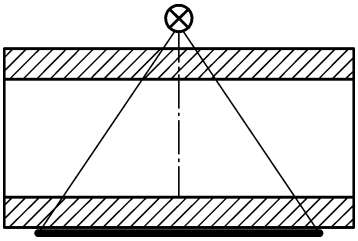


Figure 5 — Test arrangement for double wall radiography of plane or curved test areas; source and film outside the test area, only the film side wall imaged for interpretation

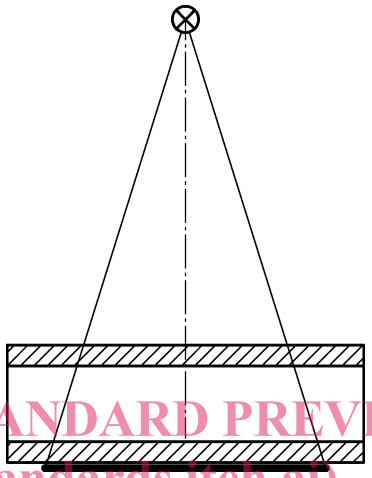


Figure 6 — Test arrangement for double wall radiography of plane or curved test areas; several exposures; source and film outside of the test area; both walls imaged for interpretation

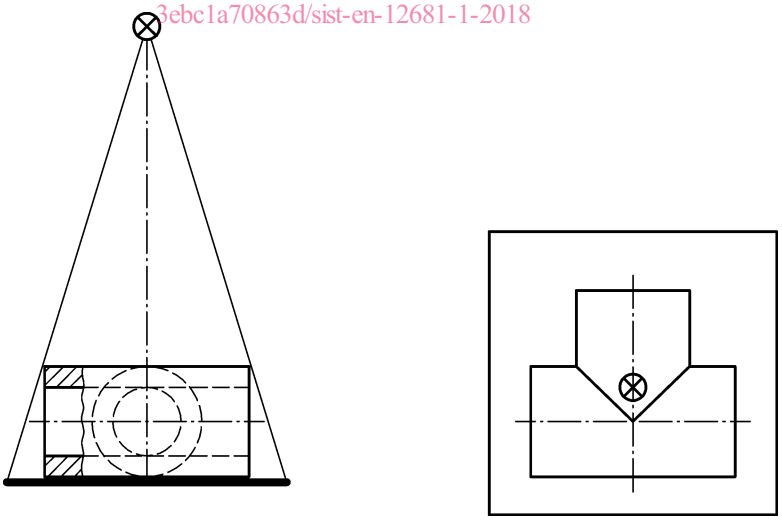


Figure 7 — Test arrangement for double wall radiography of plane or curved test areas; overview exposure; source and film outside of the test area; both walls imaged for interpretation