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Non-destructive testing — Radiographic testing of metallic materials using film and X- or gamma rays — Basic rules

Essais non destructifs — Contrôle radiographique des matériaux métalliques au moyen de film et de rayons X et gamma — Règles de base

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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 rules given in the ISO/IEC Directives, Part 2. www.iso.org/directives

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

The committee responsible for this document is ISO/TC 135, *Non-destructive testing*, Subcommittee SC 5, *Radiation methods*.

This third edition cancels and replaces the second edition (ISO 5579:1998), which has been technically revised.

Changes from the second edition include:

— introduction of film in the title — this International Standard is valid only for NDT films as image detectors and not for digital radiographic detectors;

— reference to the state-of-the-art image quality detectors, according to ISO 19232-1 to ISO 19232-4;

— omission of figures with test arrangements (these test arrangements are described in the corresponding application standards);

— extension of applicable X-ray voltages from 500 kV up to max. 1 000 kV, depending on the penetrated wall thickness and material;

— modification of the nomogram of minimum source distances for focal spot sizes from 0,1 mm up to 8 mm;

— update of film system classes (old ISO classes T2 and T3 have been replaced by new classes C3 to C5, according to ISO 11699-1:2008);

— several editorial changes.

Introduction

This International Standard specifies fundamental techniques of radiography, with the object of enabling satisfactory and repeatable results to be obtained economically. The techniques are based on generally accepted practice and the fundamental theory of the subject.

Standards relating to specific applications should conform to these basic rules.

Non-destructive testing — Radiographic testing of metallic materials using film and X- or gamma rays — Basic rules

1 Scope

This International Standard outlines the general rules for industrial X- and gamma-radiography for flaw-detection purposes, using film techniques, applicable to the inspection of metallic products and materials.

It does not lay down acceptance criteria of the imperfections.

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.

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

ISO 5580, *Non-destructive testing — Industrial radiographic illuminators — Minimum requirements*

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

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

ISO 19232-2, *Non-destructive testing — Image quality of radiographs — Part 2: Determination of the image quality value using step/hole-type image quality indicators*

ISO 19232-3, *Non-destructive testing — Image quality of radiographs — Part 3: Image quality classes*

ISO 19232-4, *Non-destructive testing — Image quality of radiographs — Part 4: Experimental evaluation of image quality values and image quality tables*

EN 12543 (all parts), *Non-destructive testing — Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing — Part 2: Pinhole camera radiographic method*

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

3 Terms and definitions

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

3.1
nominal thickness
t
nominal thickness of the material in the region under examination

Note 1 to entry: Manufacturing tolerances do not have to be taken into account.

3.2
penetrated thickness
w
thickness of material in the direction of the radiation beam calculated on basis of the nominal thicknesses of all penetrated walls

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

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

Note 1 to entry: Source size is according to EN 12543 for X-ray tubes or EN 12679 for gamma ray sources.

3.5
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 is the sum of the source-to-object distance (3.6) and the object-to-film distance (3.3).

3.6
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

4 Classification of radiographic techniques

The radiographic techniques are divided into two classes:

1) Class A: basic techniques;

2) Class B: improved techniques.

Class B techniques will be used when class A might be insufficiently sensitive.

Better techniques compared with class B 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 parties concerned.

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. The loss of sensitivity shall be compensated by an increase of minimum density to 3,0 or by selection of a better film system class with a minimum density of 2,6. The other conditions for class B remain unchanged, especially the image quality achieved (see 5.7). Because of the better sensitivity compared to class A, the test specimen may be regarded as being examined to class B.

5 General

5.1 Personnel qualification

Personnel performing non-destructive testing in accordance with this International Standard shall be qualified in accordance with ISO 9712 or equivalent to an appropriate level in the relevant industrial sector.

5.2 Protection against ionizing radiation

WARNING — Exposure of any part of the human body to X-rays or gamma ray 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.

5.3 Surface preparation and stage of manufacture

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

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

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 or photographs.

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 Image quality indicator (IQI)

The quality of image shall be verified by use of an IQI in accordance with specific application standards and ISO 19232-1, ISO 19232-2, ISO 19232-3, and ISO 19232-4.

6 Recommended techniques for making radiographs

6.1 Test arrangements

Test arrangements shall be determined by the specific application standards.