AFNOR ASSOCIATED STANDARDS

Valid Standards.

NF EN ISO 5579
Non-destructive testing - Radiographic testing of metallic materials using film and X- or gamma rays - Basic rules

NF EN 12681
Founding - Radiographic examination

NF EN ISO 17636-1
Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film

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

NF EN 25580
Non-destructive testing - Industrial radiographic illuminators - Minimum requirements

DIGITAL RADIOGRAPHY/ RADIOSCOPY

NF EN 14784-1
Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 1: Classification of systems (en projet ISO/DIS 16371-1)

NF EN 14784-2
Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 2: General principles for testing of metallic materials using X-rays and gamma rays

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

NF EN 13068-3
Non-destructive testing - Radioscopic testing - Part 3: General principles of radioscopic testing of metallic materials by X- and gamma rays

IQI

NF 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

NF 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

NF EN ISO 19232-3
Non-destructive testing - Image quality of radiographs - Part 3: Image quality classes

NF EN ISO 19232–5
Non-destructive testing - Image quality of radiographs- Part 5: Determination of the image unsharpness value using wire-type image quality indicators

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Photos credits : Groupe Institut de Soudure/S. Meyer, CTIF.

COFRENDEdition_March2016

GOUVERNANCE DIRECTION
ORGANISATION PROFESSIONNELLE
CERTIFICATION ET QUALIFICATION
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NON-DESTRUCTIVE TESTING METHODS

RADIOGRAPHIC TESTING

This NDE method, discovered over 100 years ago and in constant evolution, is frequently used to penetrate a material and check its internal soundness.

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RADIOGRAPHIC TESTING

DISPLAYING LACK OF MATERIAL IN THE VOLUME OF AN OBJECT

Fields of application

Radiographic Testing is used in industry to check the internal health of a part.

It can detect any type of cavity or foreign material contained inside a part.

Flat discontinuities are revealed when the rays are emitted parallel to the plane of the indication.

The size of the discontinuities that can be detected will depend on the thickness of the material.

The method is less sensitive for dense or thick materials.

Radiographic Testing is used for inspecting welds and for detecting foundry imperfections. It is also used to check the integrity of composite structures.

Principle

Radiographic inspection is a non-destructive testing method by which an image of the density of the material of an object is obtained by X or gamma electromagnetic radiation. This image is obtained using a detection agent which can be one of the following:

- silver film,
- a reusable storage phosphor imaging plate with memory,
- a set of digital detectors.

The method is based on the differential absorption of the material according to the atomic number of the atoms of which it is composed, and its specific density. Any lack of material will cause lower absorption and show up locally as a higher optical density on the film, or a higher level on the grey scale in the case of digital imaging.

In industrial radiographic testing, the X-rays are most often produced by an X-ray tube or by a particle accelerator for high energy applications. The sources of Gamma rays used in industrial applications are Iridium 192, Cobalt 60 and Selenium 75.

This method produces a 2D image showing any lack of material in the volume of the object being tested. There is also an examination technique based on the absorption of electromagnetic rays to indicate the density of the material through volume elements. It is called tomography or volume imaging.

Owing to the ionizing radiation produced by X or Gamma rays, strict instructions must be followed when performing radiographic tests.

Examination mode

Those techniques using films or storage phosphor imaging plates produce a latent image when exposed to the rays.

Photographic «silver» film is developed manually or in an automatic machine. The resulting radiograph is a negative in varying shades of grey according to the quantity of radiation transmitted. The degree of blackness of the film depends on its optical density or capacity to absorb light. The film is viewed using an illuminator with a high intensity light source. Any lack of material in the object will show up as dark areas on the radiograph.

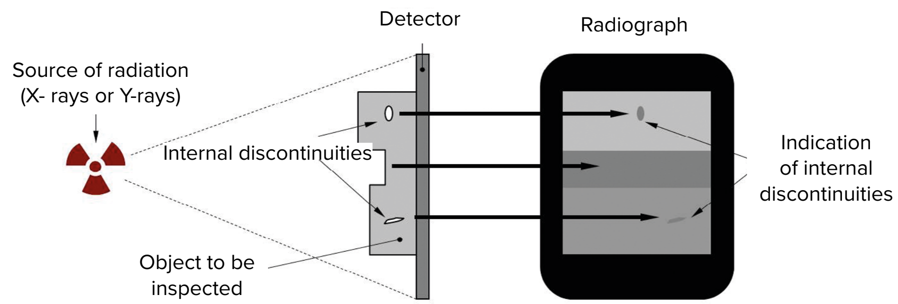
The latent image produced on the storage phosphor imaging plate is developed using a CR reader that digitizes the image. In this case, the radiographic image is processed in the form of a digital file defined by the number of pixels and its grey scale code. Once the imaging plate has been read, the image is erased by restoring the radiation-sensitive layer to a stable energy level. Imaging plates can therefore be reused again and again. Digital scanners fall into two main types, half-moon or cassette. The latter are less fragile and more suited to industrial use, but do not allow curved areas of parts to be mapped. The digital images obtained can be processed to facilitate the detection of any indications. This radiography technique using storage phosphor imaging plates is known as CR (Computed Radiography).

There are other types of detector able to directly produce a digital radiograph. They are used on stationary equipment comprising a remote controlled handling system to change the position of the object (or an area of it) in relation to the radiation source.

The objects tested can either be viewed in real time by the operator, recorded on video (radioscopy), or viewed on the processed images. When these digital images are recorded, it is possible to apply an operation to optimize the contrasts or processing of the images (mathematical filtering). While previously the detector was a light amplifier coupled with an optical camera, this system has now been replaced by a series of digital sensors most often assembled in the form of a flat panel (FPD). This is the DR (Direct Radiography) technique.

Sometimes ultra- high resolution (around 31 µm) CCD cameras are used for automatically testing large aeronautics structures. These may be combined with a fibre-optic coupler positioned at the detector input.

Principles of radiography



ADVANTAGES OF THE METHOD

The main advantage of radiography is its ability to provide a clearly defined image of the uniformity of the material of a part. It is easy to detect contrasted indications and to distinguish between the various types of indications. In comparison to ultrasonic test methods, it is more compatible with variations in surface roughness and in the internal structure of the material. It can be used with all types of materials (aluminium, steel, copper alloys, titanium, composite materials, etc.). The limitations of the method are related to the high cost of the equipment and consumables and the risks of ionizing radiation which requires strict compliance with regulations and instructions.