Non destructive testing - Radiation method - Computed tomography - Part 2: Principle, equipment and samples

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Foreword

This document (EN 16016-2:2011) 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of an identical text or by endorsement, at the latest by February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.

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 16016 consists of the following parts:

— *Non destructive testing — Radiation methods — Computed tomography — Part 1: Terminology*;

— *Non destructive testing — Radiation methods — Computed tomography — Part 2: Principle, equipment and samples*;

— *Non destructive testing — Radiation methods — Computed tomography — Part 3: Operation and interpretation*;

— *Non destructive testing — Radiation methods — Computed tomography — Part 4: Qualification*.

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Introduction

This document gives guidelines for the general principles of X-ray computed tomography (CT) applicable to industrial imaging (in the context of this standard, industrial means non-medical applications); it also gives a consistent set of CT performance parameter definitions, including how these performance parameters relate to CT system specifications. This document deals with computed axial tomography and excludes other types of tomography such as translational tomography and tomosynthesis.

1 Scope

This European Standard specifies the general principles of computed tomography (CT), the equipment used and basic considerations of sample, materials and geometry.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

EN 16016-1:2011, *Non destructive testing — Radiation method — Computed tomography — Part 1: Terminology*

EN 16016-3:2011, *Non destructive testing — Radiation methods — Part 3: Operation and interpretation*

EN 16016-4:2011, *Non destructive testing — Radiation methods — Part 4: Qualification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16016-1:2011 apply.

4 General principles

4.1 Basic principles

Computed tomography is a radiographic inspection method which delivers three-dimensional information of an object from a number of radiographic projections either over cross-sectional planes (CT slices) or over the complete volume. Radiographic imaging is possible because different materials have different X-ray attenuation coefficients. In CT images, the X-ray linear attenuation coefficients are represented as different CT grey values (or in false colour). For conventional radiography the three-dimensional object is X-rayed from one direction and an X-ray projection is produced with the corresponding information aggregated over the ray path. In contrast, multiple X-ray-projections of an object are acquired at different projection angles during a CT scan. From these projection images the actual slices or volume are reconstructed. The fundamental advantage compared to radiography is the preservation of full volumetric information. The resulting CT image (2D CT slice or 3D CT volume), is a quantitative representation of the X-ray linear attenuation coefficient averaged over the finite volume of the corresponding volume element (voxel) at each position in the sample.

The linear attenuation coefficient characterizes the local instantaneous rate at which X-rays are attenuated as they propagate through the object during the scan. The attenuation of the X-rays as they interact with matter is the result of several different interaction mechanisms: Compton scattering and photoelectric absorption being the predominant ones for X-ray CT. The linear attenuation coefficient depends on the atomic numbers of the corresponding materials and is proportional to the material density. It also depends on the energy of the X-ray beam.

4.2 Advantages of CT

Computed tomography (CT) is a radiographic method that can be an excellent examination technique whenever the primary goal is to locate and quantify volumetric details in three dimensions. In addition, since