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Radiation protection instrumentation - Measuring the imaging performance of X-ray computed tomography (CT) security-screening systems

National foreword

This British Standard is the UK implementation of IEC 62945:2018.

The UK participation in its preparation was entrusted to Technical Committee NCE/2, Radiation protection and measurement.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Radiation protection instrumentation – Measuring the imaging performance of X-ray computed tomography (CT) security-screening systems

Instrumentation pour la radioprotection – Mesure des performances d'imagerie des systèmes de contrôle de sécurité utilisant la tomographie par ordinateur (CT) à rayons X

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RADIATION PROTECTION INSTRUMENTATION – MEASURING THE IMAGING PERFORMANCE OF X-RAY COMPUTED TOMOGRAPHY (CT) SECURITY-SCREENING SYSTEMS

FOREWORD

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International Standard IEC 62945 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
45B/908/FDIS	45B/910/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This document establishes standard test methods and test objects for measuring the imaging performance of x-ray computed tomography (CT) security-screening systems. The quality of data for automated analysis is the primary concern. This document does not address the system's ability to use its image data to automatically detect explosives or other threat materials, which is typically verified by an appropriate regulatory body.

Three annexes are included. Annex A (normative) provides mechanical drawings of the imaging test objects that compose the test article. A sample test report form is given in Annex B (informative). Annex C (informative) offers statistical guidance on multiple scans, summary statistics, and comparison of results. Finally, a bibliography is given (informative).

RADIATION PROTECTION INSTRUMENTATION – MEASURING THE IMAGING PERFORMANCE OF X-RAY COMPUTED TOMOGRAPHY (CT) SECURITY-SCREENING SYSTEMS

1 Scope

This document provides test methods for the evaluation of image quality of computed tomography (CT) security-screening systems. The quality of data for automated analysis is the primary concern. This document does not address the system's ability to use this image data to automatically detect explosives or other threat materials, nor is it intended for vendor-to-vendor comparisons of threat-detection performance.

Security screening systems are generally used to scan parcels, including luggage, for the presence of illicit items such as explosives, drugs, or other contraband. Many of the screening systems currently used, particularly in transportation security applications, are based on CT imaging technology. Generally, as the parcel is transported through the system, the system collects a CT image of the parcel. These data are then subjected to automated analysis to determine whether a threat may be present or the parcel is considered clear. If the automated analysis determines a threat may be present, the image is often presented to a system operator who can override the automated decision, clearing the parcel, or referring it for further processing such as opening it and manually searching for threats.

Historically, government regulators have established evaluation procedures to determine whether a system's automated detection performance is adequate for use in applications within their borders. Typically, a vendor submits a copy of their product, including their software to the regulator's facility. The regulator runs a wide variety of parcels with threats inside through the system as well as parcels without threats that represent the typical stream of commerce. Detection and false alarm rates are determined and compared against performance criteria. If the criteria are met, the system is approved for use. This testing ensures that the system is capable of meeting the required criteria, but how does one ensure that all copies of the system meet the criteria? Normal manufacturing variability, quality control issues, or aging of the equipment may degrade performance versus what was observed on the article tested by the regulator. Replicating the original test on each machine in question is impractical. Transporting the regulator's threat set to a factory site or to locations where the machines are in use presents significant security and in some cases safety concerns. This document seeks to address this issue by specifying a suite of test methods that can be carried out on site without need for hazardous materials.

The performance testing carried out by the regulators essentially evaluates the combination of the system's ability to produce an image of the parcel along with its automatic analysis of that image data to reach a decision of threat or clear. The second part of this sequence, the analysis, is implemented through software. Regulators generally require that this software be designed so as to not evolve through use. The software used at all locations in the field must perform the same as the software did at the time of evaluation by the regulator. Configuration management of such software is a well-known and straightforward art. Therefore, the real opportunity for performance variation comes from the imaging system that provides the data to the analysis software. If one can quantitatively validate that the quality of the image produced by the system in question is statistically equivalent to the image produced by the article evaluated by the regulator, one can be highly confident that the performance of the system in question is the same as what was approved by the regulator.

Purchasers of CT systems for security screening applications are generally not CT experts. Inconsistencies in methods for measuring seemingly standard image quality values (resolution, signal-to-noise, etc.) can confuse the potential user of such CT systems. Other standards exist for testing aspects of CT image quality, particularly in the medical field. This document specifies a set of methods to apply in assessing CT image quality geared towards security