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Ensuring Precision: Quality Control Solutions in Multi-Energy Computed Tomography

In the rapidly evolving field of medical imaging, precision and accuracy are paramount. Multi-energy computed tomography (MECT) offers enhanced material differentiation and improved diagnostics. Ensuring the highest quality of these advanced imaging techniques requires robust quality control measures and appropriate phantoms as outlined in the recently published AAPM Task Group Report 299.

In conventional computed tomography (CT) imaging, which uses a single polyenergetic spectrum, materials with different effective atomic numbers can exhibit identical CT values at the same energy level, making material differentiation challenging. However, multi-energy applications allow for the differentiation of materials with different effective atomic numbers due to their distinct linear attenuation coefficients at both high and low energy levels.

As a phantom specialist with over 30 years of experience, QRM, a PTW company since 2020, offers various solutions for the quality control of all available multi-energy applications (e.g., photon-counting detector CT, dual-layer CT, kV-switching, dual-source CT), for the assessment of image quality parameters, as well as for radiation dose evaluation, as recommended in the AAPM Task Group Report 299.

Phantom Solutions for Testing Dual-Energy, Multi-Energy, and Photon-Counting CT Protocols

The QRM Multi-Energy QA Phantom is designed for evaluating and testing all available multi-en-

ergy imaging techniques, providing a comprehensive solution to clinical demands. It includes standard inserts enriched with various contrast media (water and iodine, adipose and iodine) and calcium (water and calcium hydroxyapatite) in different concentrations. Customised inserts or different sets, such as Gadolinium for multi-contrast applications, are also available. Additionally, extension rings or axial expansion sets make this phantom ideal for testing various CT modalities and clinical scenarios, regardless of the manufacturer or scanner model.

An automated analysis software simplifies image quality tests across various spectral CT technologies from different manufacturers. After scanning the QRM Multi-Energy QA Phantom with multi-energy, dual-energy, or photon-counting CT protocols, the software automatically evaluates the image quality parameters. The opaquely numbered inserts of the phantom enable seamless, fast, and accurate evaluation reports for quality control assessments. The software's easy-to-use interface supports inserts made to customer specifications, enhancing assessment capabilities and overall precision.

Simulation of environmental tissues and organs

The QRM Spectral CT Phantom, suitable for the quality control of multi-energy applications, includes 12 inserts for 8 boreholes. It houses different test inserts of solid tissue-equivalent materials or tubes that can be filled with water or contrast media. With its compact design and 100 mm diameter, this phantom can be used in com-



Figure 1. QRM Multi-Energy QA Phantom: Versatile for photon-counting and all spectral CT protocols.

Combination with the QRM Thorax or QRM Abdomen Phantom to mimic additional organs and tissues, such as lung tissue, liver, or spleen.

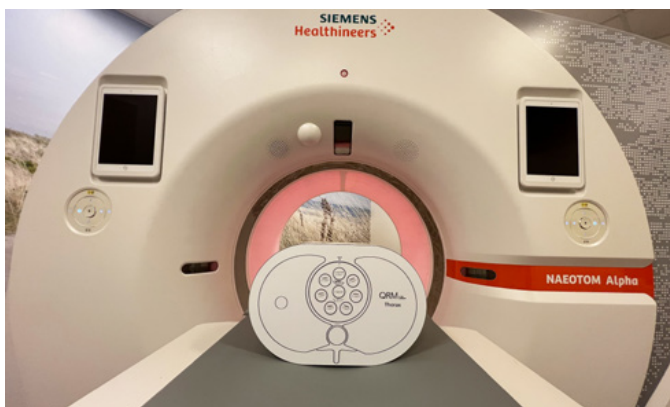


Figure 2. QRM Spectral CT Phantom for different types of multi-energy applications. All materials tested on NAEOTOM Alpha.

Assessment of image quality parameters

The tissue-equivalent QRM Cone-Beam Phantoms (Expert or Basic) consist of different sections, allowing comprehensive evaluation of all essential image quality parameters within a single compact phantom. Performance parameters, including in-plane spatial resolution, modulation transfer function (MTF) in different orientations, low-contrast resolution, contrast-to-noise ratio, in-plane geometrical accuracy, image homogeneity/noise, and CT number linearity (scaling), can all be evaluated in just one scan.

Explore our comprehensive [Codes of Practice](#) for clear explanations of the physics and methods used to assess image quality parameters with various QRM phantoms for different X-ray applications.

For a complete overview on phantom solutions compliant with AAPM TG-299 standards, visit the [product overview](#) on the QRM website.



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