QUART
Quality Assurance in Radiological Technologies

QUART mam/digi EPQC

Universal Mammography QA/QC Phantom

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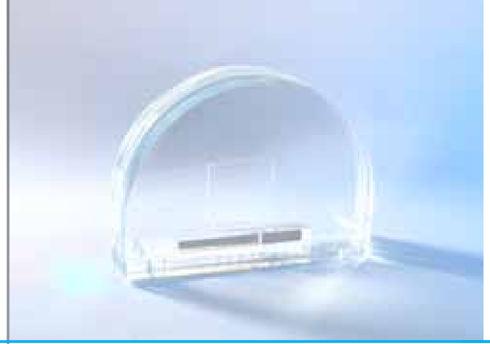
Universal Test Phantom for QA/QC procedures in Analog & Digital Mammography and Tomosynthesis



The *QUART mam/digi* phantom is designed to be used as a universal tool for QA/QC routine testing in Digital & Analog Mammography. Due to its design it can also be used as a QA/QC tool for Digital Tomosynthesis.

Only one exposure is required to collect all necessary parameters to determine the imaging quality for the x-ray equipment. After the exposure, the image can be automatically evaluated visually or through a unique QUART QA/QC software module. The test results are saved or printed out for documentation purposes.

Test Phantom

Unique in its kind, for the first time the *QUART mam/digi* phantom incorporates so-called Landolt Ring Structures. Similar to the gold structures of the CDMAM phantom, the Landolt structures are meant to verify low contrast and perceptibility limits. However, the Landolt objects are developed to compare better to the morphology of microcalcifications than any other available structure within current mammography QA/QC phantoms!

The phantom additionally enables Contrast-to-Noise Ratio (CNR) measurements over the full dynamic range of an image - ranging from peripheral to highly dense parenchyma areas.

A total of 12 steps simulate different densities of tissue material thus providing the basis for QA procedures which correspond to actual anatomical conditions. Additional attenuation can be added to simulate further thickness and density of mamma tissue. The low contrast is visually checked using the 12-step wedge.

All test objects are arranged and positioned near the thorax wall side of the mammography unit. This was intentionally done to avoid heel effect influence on the test results.

Test Procedure

Software Evaluation: After the phantom had been positioned on the bucky table, the exposure is initiated. After the exposure, a DICOM image is loaded into the *QUART mammopro* software module. The software will guide the user step-by-step through the evaluation process, collect all data from the test image and create a test protocol. The whole procedure from positioning the phantom to the software assisted evaluation and creation of the test protocol takes only about 5 minutes. Essential test parameters are displayed for evaluation(*), others are merely collected in the software's backend or are visually assessed.

Visual Evaluation: The visual evaluation of the QA/QC image is done according EUREF and EPQC protocols.

Test Parameters

_ Nyquist Frequency* (NF)
_ Contrast
_ Noise
_ Contrast-to-Noise Ratio* (CNR)
_ Homogeneity*
_ Modulation Transfer Frequency* (MTF) at 10% & 50% / Threshold Contrast
_ Visual Spatial Resolution
_ Artefacts, Image Flaws, etc.
_ Air Kerma / Dose (Dosemeter required)

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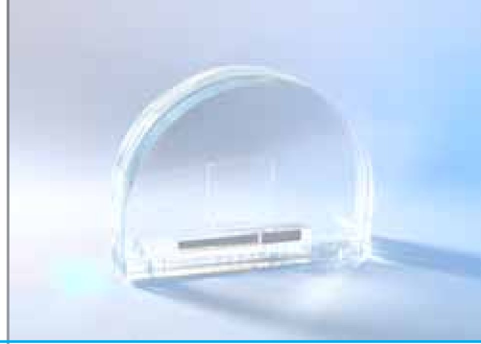

Standardisation: Situation Summary

The "European Protocol for the Quality Control of the Physical and Technical Aspects of Mammography screening – Part B: Digital Mammography" (EPQC) as well as the German "Publicly Available Specification 1054" (PAS 1054) both do not have the significance of a QA standard. Yet, these procedures have been introduced in early diagnosis programmes in Europe (Mammography Screening) using a CDMAM and/or PAS phantom.

National and international workgroups are still working on Acceptance and Constancy Test Procedures and Codes. The *QUART mam/digi* phantom in its current technical design is prepared for additional requirements as it can be modified.

The phantom has been developed after many conversations with medical physicists and service experts using additional scientific input. Hence, its test options meet current QA/QC requirements and comply with EUREF, EPQC and PAS recommendations. The phantom provides additional test options which offer substantial enhancement to image quality analyses in mammography.

Phantom Description

_ Phantom Body 240x180x65 mm (LxWxH) ①
_ Place Holder to insert additional test structures, if required (e.g. for PAS 1054) ⑥
_ Test Objects:
- 6 Landolt Objects per Group: Ø 600/480/380/310/250/180 µm ②
- One group of 6 in each dynamic step (Total of 12) ②
- Contrast Step Wedge 5 – 40 mm PMMA ②
- Additional 3-step Aluminium Wedge ②
- 2 MTF/NF Test Objects 5x5 mm each ③
- Low-Contrast Stripe 180x5 mm (LxW) ②
- Row of 12 Low-Contrast Numbers ②
- Row of Structures for Field Geometry Evaluation ④

_ Slot for Dosemeter Detector ⑤

NB: The phantom's test objects can be modified and adapted to all current or future standards and methodologies.

The QA/QC concept at present combines visual evaluation features with an analysis of computerised data to correlate the conclusions. The test procedure is laid out to be run fully automatic in the near future, thus becoming even more time and cost efficient as it already is.

Also available

QUART HVL Stand / HVL Filter Set	HVL Measurement
QUART AEC Test Set	AEC Check
QUART mammotest 1.0 & 2.0	Focal Spot Assessment Tools
QUART dido/EASY -m	Constancy Test Dosemeter
QUART al20	Added Filtration for Mammography QA/QC

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