

61. APPENDIX M: ULTRASOUND SYSTEM PERFORMANCE AND QUALITY CONTROL

Quality assurance is of the greatest importance in breast screening and this applies no less to the ultrasound equipment used in assessment than it does to the mammographic X-ray units. The requirements for quality assurance specified below are based on the American Association of Physicists in Medicine (AAPM)

M:1 ULTRASOUND USER TESTS

The test to be performed are as detailed below.

TABLE M:1 ULTRASOUND USER TESTS

Procedure

Visual Inspection:	Monthly	Check all cables for signs of damage and/or wear and tear. Check each transducer and its cable for similar signs or cracks, chips and so on.
Hard copy device:	Monthly (Can be reduced to 6 monthly by the Medical Physicist)	Use the ACR Stereotactic Hardcopy protocol (ACR 1999 b), or similar manufacturer’s protocol, preferably employing a SMPTE (or similar) pattern.

M:2 ULTRASOUND ACCEPTANCE TESTING/ BASELINE READINGS

These tests shall be performed by a Medical Physicist with training and experience in diagnostic ultrasound. The initial visit to an ultrasound scanner is to:

1. compile the machine performance profile (baseline measurements) for both the user and the Medical Physicist’s tests
2. determine compliance with the manufacturer’s declared performance and the radiologists’ National Quality Standards document.

All the tests described below should be performed and recorded in a standardised manner. Locally it may be considered appropriate, perhaps because of the availability of test objects, to extend the range of tests (e.g. to include power output).

recommendations⁹² and the American College of Radiology Ultrasound⁹³ and Ultrasound Guided Breast Biopsy Accreditation Programmes.⁹⁴

M:1 Ultrasound User Tests

M:2 Ultrasound Acceptance Testing/Baseline Readings

M:3 Ultrasound Performance Assessment Tests

M:3 ULTRASOUND PERFORMANCE ASSESSMENT TESTS

These tests shall be performed by a Medical Physicist with training and experience in diagnostic ultrasound, the National Screening Unit will make tissue equivalent phantoms available for these tests. The Medical Physicists Unidisciplinary Group will produce and maintain a set of protocols.

For all procedures it is essential that system settings are well described and reproducible. Settings that should be recorded are:

1. transducer model/serial number
2. dynamic range
3. grey level map (where available)
4. power level
5. gain
6. Time Gain Control (TGC) settings
7. mode (where relevant)
8. set focal length (may be multiple focal zones)
9. depth of tissue (range).

92 Goodsitt MM et al. 1998.

93 ACR 1998 a

94 ACR 1998 b.

TABLE M:2 ULTRASOUND SYSTEM QUALITY CONTROL AND PERFORMANCE REQUIREMENTS

Procedure*	Minimum Frequency	Procedure Elements	Control Limits/ Requirements
Physical and mechanical inspection	Six-monthly	Inspection of transducers, power cords, controls and system cleanliness.	Satisfactory operation and condition.
Display monitor set-up and fidelity	Six-monthly	Verification that contrast and bright-ness settings are in baseline positions. Evaluation of number of grey scale test pattern steps visible. Evaluation of clarity of displayed text.	Number of grey scale test pattern steps visible should not decrease by more than 2.
Image Uniformity	Six-monthly	Evaluation of a uniform region of tissue-mimicking phantom and identification of deviation from smooth tissue texture.	No significant non-uniformities.
Depth of penetration/ visualisation	Six-monthly	Evaluation of maximum depth of either ultrasound speckle or object perception.	<6 mm change in depth of penetration/visualisation.
Hard copy fidelity	Six-monthly	Comparison of on-screen image and hard copy image. Verification that the weakest echoes visible on the display are visible in the hard copy image. Comparison with baseline image.	No significant change from baseline images.
Distance Accuracy	Six-monthly	Measurement of known distances in vertical and horizontal directions.	Vertical measurement error less than 1.5 mm or 1.5%. Horizontal measurement error less than 2 mm or 2%.
Anechoic object imaging	Six-monthly	Evaluation of image quality. Comparison with baseline images.	No major distortion or change from baseline performance.
Axial resolution	Six-monthly	Evaluation of full-width half-maximum (FWHM) from profile. OR Evaluation of filament targets in an axial resolution grouping.	Resolution \leq 1 mm. No significant change from baseline values.
Lateral resolution or response width	Six-monthly	Measurement of filament image width. OR Evaluation of FWHM from image profile OR Evaluation of filament targets in a lateral resolution grouping.	FWHM < 0.8 mm Image width or spacing between targets < 1.5 mm No major change from baseline values.
Ring down or dead zone	Six-monthly	Imaging of filament targets near scanning window. OR Evaluation of image texture features.	Dead zone < 4 mm (for > 7 MHz transducer).
Review of User QC	Six-monthly		

* Procedure should be repeated for each transducer (excluding Display Monitor Set-up and Hardcopy fidelity).