Guidance on Quality Control processes for Imaging in Radiography: Direct Digital Radiography (DDR) & Computed Radiography (CR) including display monitors

ISRRT Board approved – July 2019
The ISRRT endorses quality assurance (QA) and quality control (QC) within the scope of practice for radiographers/radiological technologists using an integrated team approach.
Guidance on QC processes for Imaging in Radiography

**QC Includes:**

- Patient’s journey through the clinical imaging or radiotherapy service
- Use of ionizing and non-ionizing radiation modalities.
Guidance on Quality Control processes for Imaging in Radiography

Diagnostic Imaging includes:

• Protocols and procedures linked to specific imaging exams
• Evaluation and monitoring of patient doses received for individual radiological examination
• Reject analysis
• Accuracy of diagnostic imaging reports.
Guidance on Quality Assurance processes for Imaging in Radiography

QA Embraces all Aspects of the Diagnostic Imaging Process including:

• Visual checks of the equipment
• Confirmation of careful preparation prior to every patient procedure
• Establishing a routine quality control testing programme of equipment-
  daily, weekly, monthly, quarterly, annually
Guidance on Quality Control processes for Imaging in Radiography

Quality Control Testing

QC Testing includes:

• Monitoring
• Evaluation
• Maintenance of equipment for optimal performance and stability

It is essential that radiographers/radiological technologists recognize, record, and report according to policy; when a significant increase or underexposure in radiation exposure occurs.
Guidance on Quality Assurance processes for Imaging in Radiography

Professional Requirements Essentials in Integral QA Components:

• Analyzing the results of QC testing
• Validating QA testing conditions and results
• Reporting significant tolerance deviations from QC tests to appropriate personnel
• Initiating corrective action immediately
The role for radiographers/radiological technologists in Quality Control processes includes:

Documenting and maintaining records for the QC program in accordance with applicable regulations, legal requirements, accrediting agencies, and recommendations from equipment manufacturers.

This role is subject to the demonstration of appropriate educational preparation within the scope of practice for radiographers/radiological technologists.
Guidance on Quality Control processes for Imaging in Radiography

Competent radiographers/radiological technologists should be responsible for:

- Overseeing the equipment QC testing programme
- Other responsibilities in the QA framework of the radiology department
- Embracing all imaging modalities and quality improvement projects.
Guidance / References on Quality Control processes for Imaging in Radiography


Many countries require that the Employers make arrangements for a suitable QC programme for all radiological equipment.

The Employer should consult the appointed Radiation Protection Adviser (RPA) about the QC programme.

There are many guidance documents / references containing recommended standards for the QC of equipment.
Guidance on Quality Control processes for Imaging in Radiography

The QC programme should:

- Specify the frequency of testing
- Contain a written protocol detailing how to perform the testing
- Specify who has responsibility for carrying out the testing
- Contain appropriate action level(s) for each test result
- Identify the remedial actions required in the event that the action level(s) deviates
- Make clear who has responsibility for acting on adverse findings within the local published time limits for undertaking such actions to report and remedy the situation
- Maintain records for all the QC tests and actions necessary to rectify any issues arising from the QC tests
Most countries legislation indicate that it is for the Employer to decide who undertakes the testing – this can be the Employer’s own staff or contractors.

The protocol should include sufficient information as to allow the test set-up and technique to be accurately reproduced. Requires detailed information on the following for each test being performed:

- Test equipment to be used
- Positioning of both the x-ray and test equipment
- Exposure factors
- Results to be recorded following the test, including where to record it
- Action level(s) – remedial or suspension
Guidance on Quality Control processes for Imaging in Radiography

- The remedial actions required in the event that the action level(s) are varied.
- If the remedial action is escalated, a named individual along with contact details should be included to expedite the remedial action.
- If the remedial action is to suspend the equipment from use, details on how that is to be communicated to all potential users should be included.
- Where to record details on the action taken in the event that action level(s) vary.

The choice of remedial and suspension actions is a local decision that should be taken with expert advice. Usually this will have come from the Radiation Protection Adviser (RPA).

Compliance with most countries legislation all protocols will require periodic review.
Guidance on Quality Control processes for Imaging in Radiography – Radiographer/RT responsibility

Routine performance testing of Diagnostic X-ray Imaging Systems is based on recommended standards agreed by relevant professional organisations and endorsed by individual country legislation.

Generally speaking these tests are divided into two levels of expertise:-

**Level A**
- Applicable to the more frequent, quick and simple pass/fail tests
- Generally do not require sophisticated test equipment or detailed analysis.
- These tests are likely to be undertaken by the radiology department staff.

**Level B**
- Applicable to less frequent, more analytical tests
- Requiring greater equipment resources and expertise.
- These are most likely to be undertaken by medical physics staff or specially trained radiographers.

The following slides illustrate the role of the Radiographer in Level A testing giving details of the physical parameters to be tested together with the frequency of such tests and the corresponding remedial and suspension levels as illustrated in the *Institute of Physics and Engineering in Medicine (IPEM) IPEM Report 91*. However the actual parameters adopted should be agreed with the local Medical Physics Department and Radiation Protection Adviser.
Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

Level A - X-ray Tubes and generators – testing criteria

<table>
<thead>
<tr>
<th>Physical Parameter</th>
<th>Frequency</th>
<th>Remedial level</th>
<th>Suspension level</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray/light beam alignment</td>
<td>1-2 monthly</td>
<td>±1cm</td>
<td>&gt;3cm</td>
</tr>
<tr>
<td>X-ray/light beam centring</td>
<td>1-2 monthly</td>
<td>±1cm</td>
<td></td>
</tr>
<tr>
<td>Light beam/Bucky centring</td>
<td>1-2 monthly</td>
<td>±1cm</td>
<td></td>
</tr>
<tr>
<td>Light beam diaphragm field size calibration</td>
<td>1-2 monthly</td>
<td>±1cm</td>
<td></td>
</tr>
<tr>
<td>Distances and scales</td>
<td>1-2 yearly</td>
<td>±1.5% of set distance</td>
<td></td>
</tr>
<tr>
<td>Film changer alignment and collimation – CR cassette</td>
<td>3-6 monthly</td>
<td>±1cm</td>
<td>±3cm</td>
</tr>
<tr>
<td>Radiation output repeatability</td>
<td>1-2 monthly</td>
<td>Mean ±10%</td>
<td>Mean ±20%</td>
</tr>
<tr>
<td>Radiation output reproducibility</td>
<td>1-2 monthly</td>
<td>Baseline ±20%</td>
<td>Baseline ±50%</td>
</tr>
</tbody>
</table>
## Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

### Level A – Computed Radiography (CR) – testing criteria

<table>
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<th>Frequency</th>
<th>Remedial level</th>
<th>Suspension level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector dose indicator monitoring</td>
<td>1-3 monthly</td>
<td>Baseline ±20%</td>
<td>Baseline ±50%</td>
</tr>
<tr>
<td>Image Uniformity</td>
<td>1-3 monthly</td>
<td>Dots/ lines apparent</td>
<td>Gross non-uniformity</td>
</tr>
<tr>
<td>Condition of cassettes and image plates</td>
<td>Suppliers recommendation</td>
<td>Dirt on plate</td>
<td>Damage to plate</td>
</tr>
<tr>
<td>Low contrast sensitivity</td>
<td>4-6 monthly</td>
<td>Baseline ±2 groups</td>
<td></td>
</tr>
<tr>
<td>Limiting Spatial resolution</td>
<td>4-6 monthly</td>
<td>Baseline minus 2 groups</td>
<td></td>
</tr>
<tr>
<td>AEC Device Sensitivity</td>
<td>1-3 monthly</td>
<td>Baseline ±30%</td>
<td>Baseline ±60%</td>
</tr>
<tr>
<td>Operation of Guard Timer</td>
<td>12 monthly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

Level A - Direct Digital Radiography (DDR) – testing criteria

<table>
<thead>
<tr>
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<th>Suspension level</th>
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<tr>
<td>Detector dose indicator monitoring</td>
<td>1-3 monthly</td>
<td>Baseline ±20%</td>
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Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

Level A – Image display monitors

<table>
<thead>
<tr>
<th>Physical Parameter</th>
<th>Frequency</th>
<th>Remedial level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image display monitor</td>
<td>Daily to weekly</td>
<td>See comments¹</td>
</tr>
<tr>
<td>condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greyscale</td>
<td>3 months</td>
<td>Ratio white to black &lt;250</td>
</tr>
<tr>
<td>Distance and angle</td>
<td>3 months</td>
<td>±5mm</td>
</tr>
<tr>
<td>calibration</td>
<td></td>
<td>±3°</td>
</tr>
<tr>
<td>Resolution</td>
<td>3 months</td>
<td>See comments²</td>
</tr>
</tbody>
</table>

1. Visual inspection of test pattern image such as SMPE or TG18-QC and appropriate cleaning methods – monitors should be clean and the perceived contrast of the test pattern consistent between monitors on the same workstation. Ref AAPM (2005) – IPEM Report 91

2. Visual inspection of test pattern image such as SMPE or TG18-QC . Review both of low contrast and high contrast resolution patterns. Check resolution at centre and periphery is consistent with and similar to baseline image Ref AAPM (2005) – IPEM Report 91
Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

Organisation and Structure

It is good practice that QA testing is overseen by one dedicated member of staff to facilitate efficiency and continuity.

Dedicated equipment testing QA files should be kept with each piece of equipment and should contain:-

• Equipment list
• Information regarding the frequency of tests
• Descriptions of the tests to be carried out (e.g. regular testing of output, AEC, collimation, fluoroscopy etc)
• Results sheets and QA report forms
• Actions that are required if the tests are “out with agreed limits”

Note It is also important that regular QA meetings are held to feedback the test results. Interpretation of the results may also be used to analyse trends in order to act in the light of any adverse findings.
Guidance on Quality Control processes for Imaging in Radiography – Radiographer responsibility

**Organization and Structure**

Records of all servicing, repairs, and fault correction should be kept in a dedicated file for that piece of equipment (with QC results).

QC tests required following a repair or maintenance check should be carried out by the designated radiographer as part of the QA programme.

Good practice would be to sign the equipment over to the engineer for the service and have it handed back with a declaration that all settings are in the same configuration.

A procedure should also be in place to ensure it is clear when a machine is in service use and not suitable for clinical use.

Regular clinical audit to underpin all aspects of the Quality Assurance programme