Equipment Quality Control for Fluoroscopy
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Imaging Physics
CancerCare Manitoba

Purpose

An equipment quality control (QC) program establishes baseline performance levels, tracks system performance over time and reveals performance trends. This document outlines the tests that are typically part of a QC program for fluoroscopic (radioscopic) systems, including C-arms. Contact Imaging Physics for assistance in setting up your program.

What are the benefits of a QC program?

- Performance degradation can be identified leading to preventative action.
- Patients benefit when equipment performance is maintained at acceptable levels.
- A QC program is an important element in achieving accreditation.

What are the components of a QC program?

The QC program is set up by the facility under the guidance of a medical physicist certified by the Canadian College of Physicists in Medicine. The program consists of acceptance testing, on-going quality control, and periodic review of QC data and outcomes. Typically, the routine QC activities are carried out by a technologist while in-depth checks are performed by, or under the guidance of, a medical physicist. A typical QC program includes the following:

Acceptance Testing

Acceptance testing must be performed by or under the oversight of a medical physicist when a system is installed, relocated (where relevant) or undergoes significant upgrades or maintenance. Acceptance testing verifies vendor specifications and establishes performance baselines. It is the facility's responsibility to make arrangements for acceptance testing by a medical physicist.

Daily

1. Inspect system operation and verify operational status. Follow manufacturer's recommendations for equipment warm-up. Check meters and audible and visual indicators for proper function. Inspect equipment for mechanical soundness and smooth motion (including collimator and compression devices).

Monthly

1. Perform an image quality test with a phantom. An image quality test based on a phantom manufactured by CancerCare Manitoba is described below. If you wish to use a manufacturer's QC test, contact Imaging Physics to confirm that the test is appropriate. If your system is a R/F system, perform this test in the mode that is most commonly used clinically. For example, if the system is used in radiographic mode the majority of the time, perform this test according to guidance document entitled "Equipment Quality Control for Digital Radiography". Refer to the phantom testing instructions below only if the system is primarily used in fluoroscopy mode.

2. Verify performance of modality displays qualitatively by displaying and evaluating an image of the SMPTE pattern or equivalent. Verify visibility of the 5% contrast patches and the absence of distortions or artefacts. Refer to the modality display QC instructions available on the Imaging Physics website.

Quarterly

1. Check table angulation and motion.

2. Confirm that all radiation protection devices are in place and function properly. Inspect lead drapes, movable shields, and all other available shields used with the system.

Annually

1. Annual testing by or under the oversight of a medical physicist to evaluate performance against vendor specifications and baseline levels established at acceptance.

2. Annual equipment QC review by a medical physicist.

With regard to the suggested test frequencies, daily refers to each day the equipment is used.

QC data should be recorded in a manner that allows monitoring of trends in performance levels. It is recommended that QC data trends be reviewed at least semi-annually.

Note that manufacturer-supplied QA software that only provides a pass or fail result is not adequate.

If CR cassettes are used to obtain spot images, the QC guidelines for radiography must also be followed.

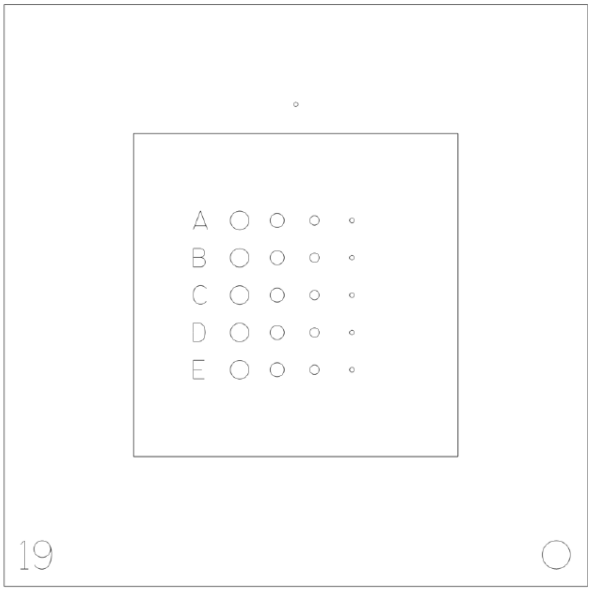
Where to go for help?

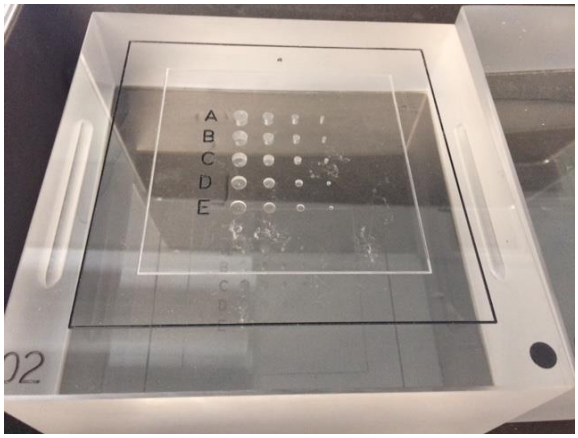
Imaging Physics at CancerCare Manitoba provides physics testing for diagnostic imaging systems, and can assist diagnostic imaging departments in setting up QC programs, training staff to perform QC tests and identifying appropriate QC tools. You can contact Imaging Physics at Imaging.Physics@cancercare.mb.ca or by calling 204-787-4145.

The fluoroscopy specialists are Dr. Harry Ingleby (204-787-2126) and Dr. Idris Elbakri (204-787-2856).

CCMB Monthly Image Quality Test

A phantom consisting of two 10 cm thick blocks of acrylic can be obtained from Medical Physics at cost. One of the blocks has a pattern of low contrast discs as shown in the figure below. This phantom can be used to quantitatively and qualitatively assess image quality.





Instructions for Phantom Image Acquisition

Setup a QC patient. It is important to use the naming convention specified by e-Health. This facilitates remote trouble shooting by the medical physicists.

Stack the two blocks in the centre of the field of view such that the dark spot in the corner of the top block is aligned with the dark spot on the lower block. The block with the discs should be on top with the discs facing the x-ray tube. Collimate the beam to just inside the edges of the phantom. If testing a C-arm, do not stack the phantom blocks on top of the detector. Acquire a fluoroscopy sequence using a common clinical protocol. You may have to press the fluoroscopy pedal for a few seconds for the exposure parameters to stabilize. Make note of the fluoroscopic pulse rate, dose mode, filtration, SID and source to phantom distance. Use identical conditions every time the test is repeated.

Examine the first row of discs (row A) on the image. If not all of the four discs are visible, remove the bottom acrylic block and use only the block with discs. If you still cannot see all the discs in row A, please contact Imaging Physics.

Record the kV, mA and dose rate obtained during live fluoroscopy.

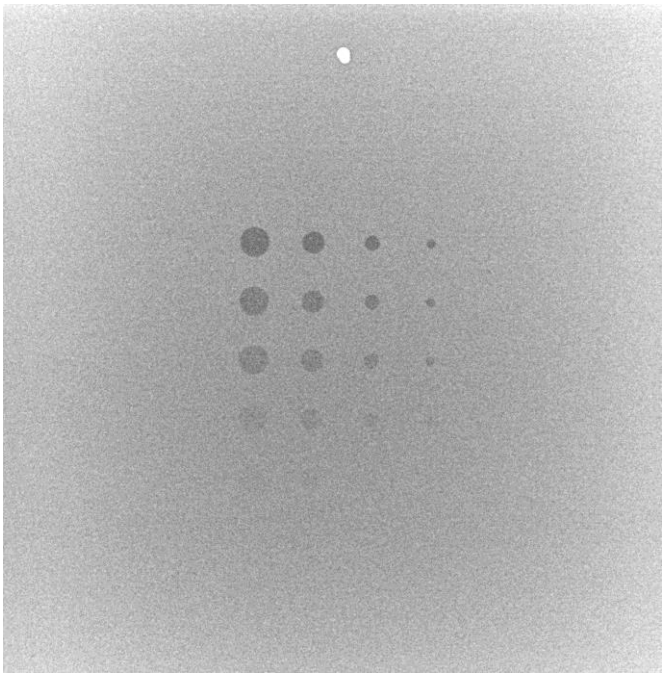
Instructions for Image Scoring

Inspect the image visually using the modality display. Use the same display every time. It is best if the same person performs the image scoring every time.

Examine rows A through E. Starting with row A, record the number of rows in which *all* 4 discs are *clearly visible*. A disc is *clearly visible* if its edges are discernible enough to circumscribe its perimeter. Stop scoring when you first encounter a row where less than 4 discs are clearly visible.

Now examine the largest disc in each row. Starting with row A and working towards row E, record the number of large discs that are clearly visible. Stop scoring when you encounter the first large disc that is not clearly visible. The same definition of "clearly visible" applies as before.

The image below gives an example of how the images are to be scored.



The image above would be scored as having 3 rows (A, B and C) where all discs are clearly visible. It would have a score of 4 for the number of large discs clearly visible.

The first time this QC test is performed establishes baseline values against which future measurements are compared. The baseline values must be established with the help of imaging physicists.

Use the spreadsheet developed by Imaging Physics to record and track your results.

Performance Criteria

If the imaging system's performance is stable, it is expected that the exposure parameters set automatically by the system, the dose, and the number of visible discs will not change significantly over time. The system passes if the number of rows in which all 4 discs are clearly visible does not decrease and the number of visible large discs does not decrease by more than 1 from baseline values. If the test fails, repeat it. If you still get a failure contact Imaging Physics.

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Annual Medical Physics Review - Fluoroscopy

This is a sample form of the annual QC review to be conducted by a medical physicist. This form is required by MANQAP to demonstrate ongoing compliance with the QC requirements.

Facility		**Department**	
System make/model		**System Location**	
Date of review		**Contact Person**	
Overall QC Program Assessment	*( ) ACCEPTABLE* *( ) ACCEPTABLE but requires remediation* *( ) NOT Acceptable. Immediate action required*	**Time period of data reviewed (mm/yy to mm/yy)**	

QC Test	Status	Comments
Daily Fluoroscopy System Inspection		
Monthly Modality Display Performance Test		
Monthly Image Quality Phantom Test		
Quarterly Table Angulation and Motion Check		
Quarterly Radiation Protective Devices Check		
Annual Physics Testing (or acceptance if equipment is new or relocated)		

Overall QC Program Assessment:

Required Changes

Review conducted by

Signature

Date

CancerCare Manitoba
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Site_____ Fluoroscopic System_____ Acquisition System__DR / II_____Room_____ Year_____

Daily and Weekly Fluoroscopy QC Log

Month																				
Day																				
Fluoroscopic system inspection																				
Month																				
Day																				
Fluoroscopic system inspection																				
Month																				
Day																				
Fluoroscopic system inspection																				
Month																				
Day																				
Fluoroscopic system inspection																				

Site_____ Fluoroscopic System_____ Acquisition System__DR / II_____Room_____ Year_____

Fluoroscopy Monthly QC Log

Year												
Month												
Image quality phantom test												
Modality display SMPTE check												

Site_____ Fluoroscopic System_____ Acquisition System__DR / II_____Room_____ Year_____

Fluoroscopy Quarterly QC Log

Year												
Day/Month												
Table angulation and motion												