FLUKE®
Biomedical

Nuclear Associates 07-647

R/F QC Phantom

Operators Manual

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Section 1
Introduction

1.1 Introduction

The R/F QC Phantom was designed to give diagnostic radiologic technologists an easy method for evaluating the image quality and performance of diagnostic radiographic and fluoroscopic imaging systems. Its design is based on the same philosophy as the Mammography Accreditation Phantom: ease of use, simplicity of evaluation, and the ability to provide useful quality control information.

The R/F QC Phantom provides a means for evaluating the constancy of the imaging system, rather than for doing a thorough evaluation. For a standard R/F system, no more than 5 minutes should be required to complete the suggested protocol. Additionally, the Phantom includes two low contrast squares to be used to verify that the brightness and contrast controls of your fluoroscopic monitor are optimally adjusted.

It is suggested that the Phantom be imaged on all radiographic and fluoroscopic equipment at least monthly. If feasible, a weekly or even daily frequency is preferable. If used daily, the Phantom will allow the technologist to determine very quickly whether or not the equipment is functioning well and if it is ready for clinical use before any patient studies begin.

It is assumed that a responsible technologist is performing the evaluation, and that the guidance of a trained Quality Control Technologist, Service Engineer or Medical Physicist is available when needed.

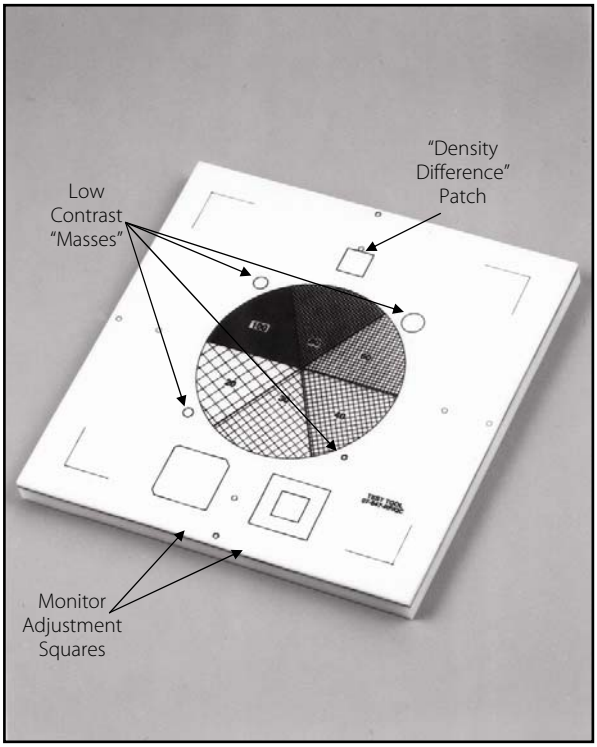


Figure 1-1. The R/F QC Phantom

1.2 Description

A schematic drawing of the Phantom is shown in Figure 1-1. At the center of the Phantom are pie-shaped wedges of varying mesh sizes: 20#, 30#, 40#, 60#, 80# and 100# for evaluating high contrast performance. Surrounding the mesh are four low contrast "masses" of different diameters: 2 mm, 4 mm, 6 mm and 8 mm. At one edge of the Phantom is a small "density difference" patch, for a measure of contrast on the films. At the opposite edge of the Phantom are two monitor adjustment squares, each having a low contrast square insert. The copper attenuator in the Phantom allows the Phantom to simulate the attenuation of a small adult. At the corners of the Phantom are lines for aligning the light field.

Section 2
Operation

2.1 Procedure

As previously stated, it is preferred that system evaluation be performed daily. System evaluation should occur prior to any patient exams, so that any difficulties detected can be rectified. For mobile c-arms, evaluation should be performed whenever the system is set up for use. During the setup and evaluation of the imaging system, you should also ensure that the system is operating correctly, *e.g.,* that the image intensifier tower moves smoothly and that the locks are working correctly. Any operational deficiencies should be reported to the appropriate personnel.

Radiographic Systems

1. Setup for the exposure
   - Select the Automatic Exposure Control mode using techniques typical for a small abdomen (e.g., 70 kVp, neutral density, center cell).
   - Record these settings.
   - Position the Phantom on the table over the AEC detectors.
   - Place a loaded cassette in the bucky tray and make the exposure.
   - Record the resultant mAs.
2. Process the film as usual
   - On the processed film, measure and record the optical density of the background, just outside the "density difference" patch.
   - Measure the optical density of the "density difference" patch.
   - Subtract this value from the background OD and record the result.
3. Evaluate the image
   - Hang the film on a viewbox.
   - Determine the *smallest* mesh pattern that can be clearly resolved.
   - Larger numbers correspond to smaller mesh patterns.
   - Record this value.
   - Determine and record the smallest low-contrast mass that can be detected.

Fluoroscopic Systems

1. Setup for the evaluation
   - Place the Phantom on the table.
   - Position the image intensifier tower approximately 12" above the table. Standardizing this height is important for ensuring reproducibility of the high-contrast mesh patterns.
   - Under fluoroscopy, center the Phantom under the image intensifier. Record the kVp and mA yielded by the system. For the monitor adjustment squares to function properly, the tube potential should be at least 70 kVp.

2. Verify the monitor setup
    - Under fluoroscopy, verify that the low-contrast inserts are visible in both monitor adjustment squares.
    - If they are not:
        - Turn both the brightness and contrast controls completely counter-clockwise.
        - Adjust the brightness so that the black video blanking circle is just visible.
        - Adjust the contrast knob until both inserts are visible and the appearance of the image is not objectionable.
3. Evaluate the fluoroscopic image
    - Determine the *smallest* mesh pattern that can be clearly resolved.
    - Larger numbers correspond to smaller mesh patterns.
    - Record this value.
    - Determine and record the smallest low-contrast mass that can be detected.
4. Evaluate the recorded image
    - Make a spot film recording of the Phantom.
    - Record the resultant kVp and mAs.
    - Process the film in the usual manner.
    - Evaluate the image, recording the smallest resolvable mesh pattern and low contrast mass.
    - This procedure may be repeated for 105 mm film and other recording devices.

If any problems are encountered, they should be reported to the QC Technologist, Service Engineer or Medical Physicist.

2.2 Analysis (See pages 2-3, 2-4 and 2-5)

As with the Mammography Accreditation Phantom, the results should be plotted on a graph rather than just recorded in a table. The graph will make it much easier to detect any trends, such as a steady but slow change in the fluoroscopic kVp or in the radiographic mAs. Such trends are an indication of degradation in imaging system performance.

A well-tuned fluoroscopy system should be able to resolve at least the 20 mesh at the center of the image in the 6" mode. From image to image, the smallest mesh visible should not decrease by more than one step and the number of masses visible should not decrease by more than one. A change larger than this should be investigated and corrected by a qualified service engineer. The fluoroscopic tube potential should be between 70 and 90 kVp.

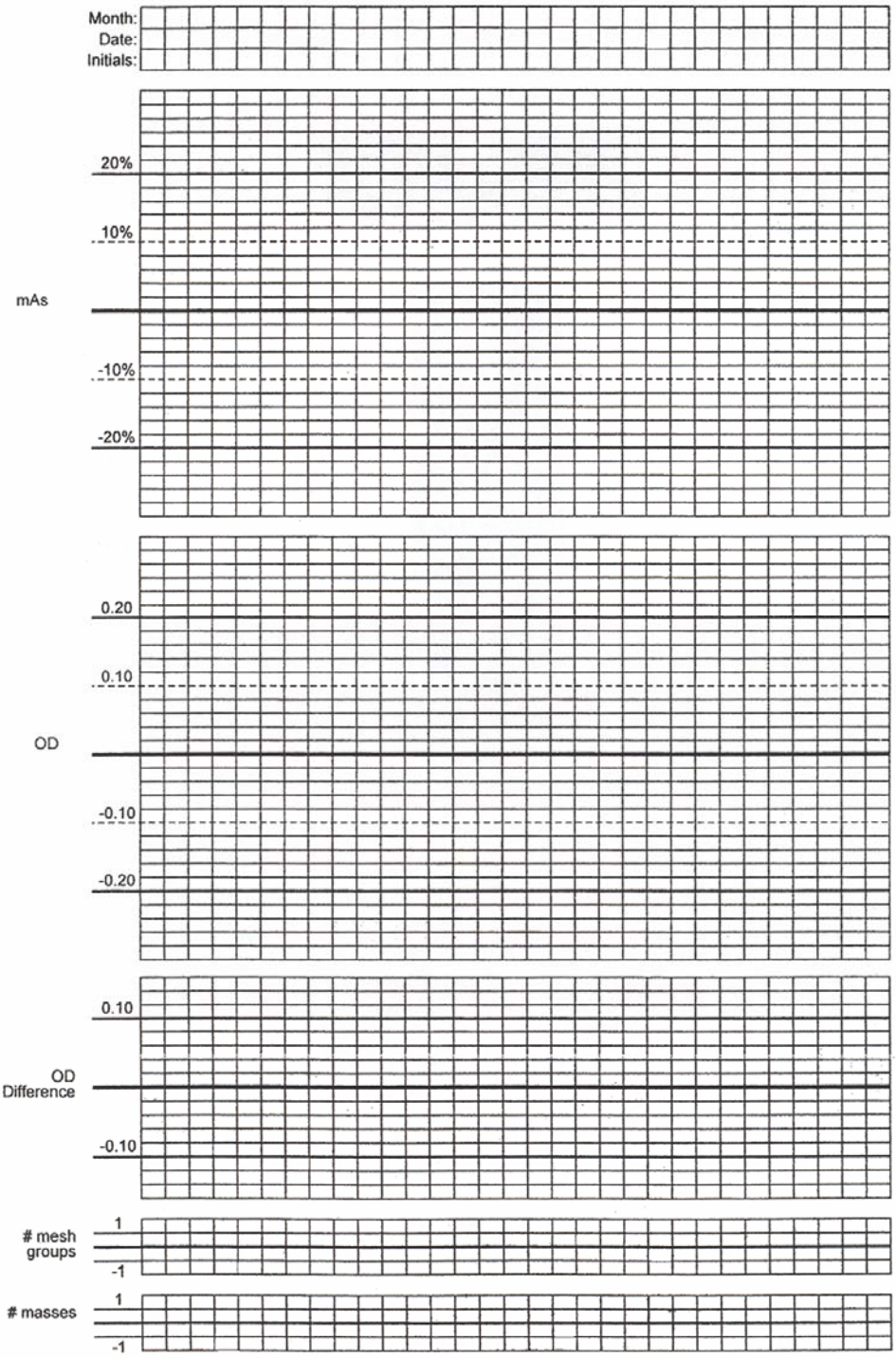
The mAs for radiographic systems, and the kVp and mA for fluoro systems should remain constant to within 10%. No trends should be observed. A trend is defined as three or more points that move in the same direction from the prior measurement. Even if a trend does not have any points that exceed the control parameters, its cause should be investigated and corrected, as it is an indication of potential system performance degradation. It is also possible to observe trends that do not move consecutively in the same direction, but instead demonstrate either upward or downward motion over a longer period of time. Such long-term trends, as when the points exceed control limits, should be monitored closely and the cause investigated and corrected by a qualified service engineer. Data demonstrating the trend may prove helpful to the service engineer, when investigating the cause.

R/F QC Test Tool Control Chart

Department: _____

Radiographic Unit / Spot Film Device

Room/Unit ID: _____ kVp Used: _____ Year: ____



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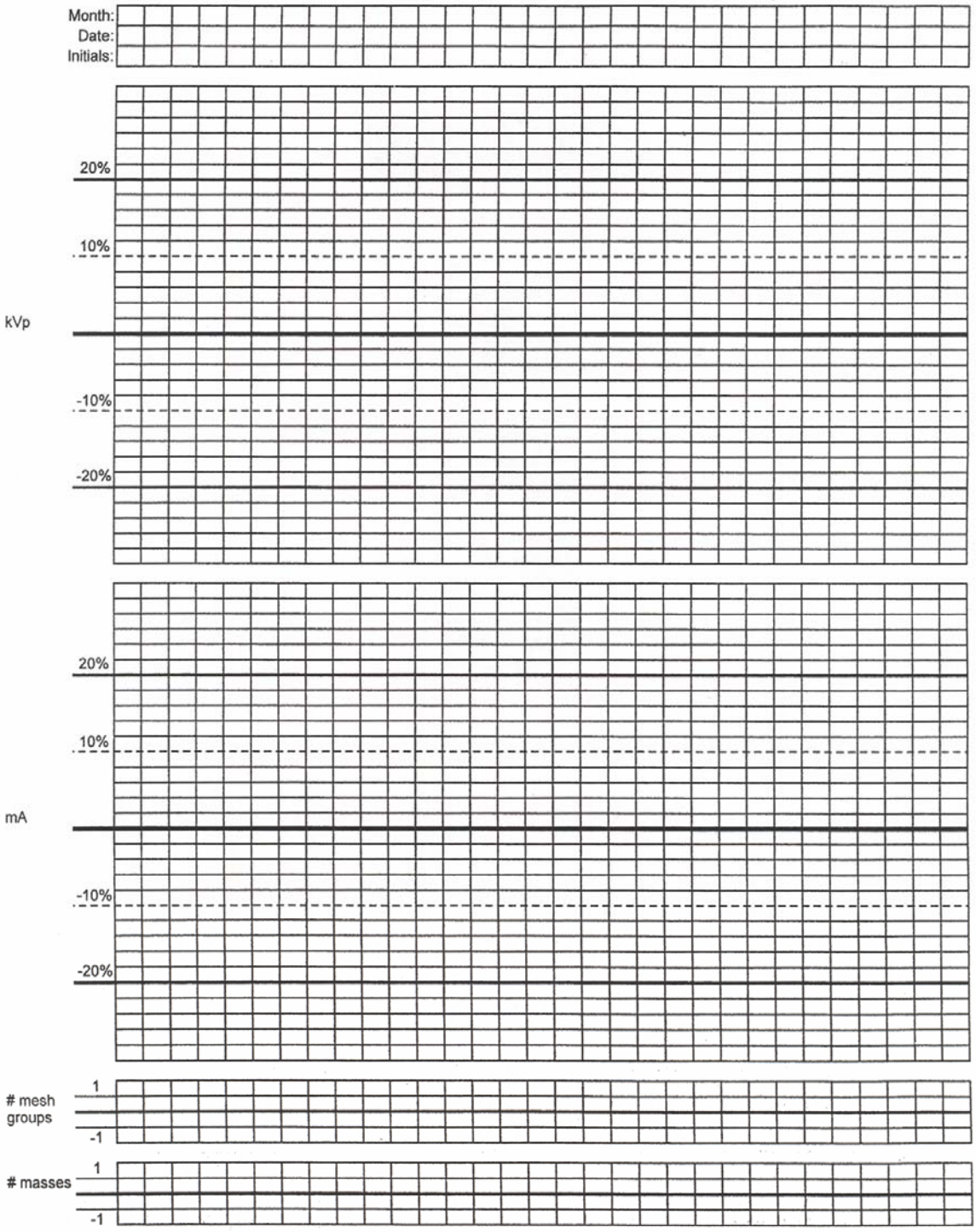
R/F QC Test Tool Control Chart

Department: _____

Fluoroscopic Unit

Room/Unit ID: _____ Year: _____



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R/F QC TEST TOOL CORRECTIVE ACTION FILE

DATE	COMMENTS
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