Y11-CR

Y11-Y17-CR Computed Radiography Image Quality

Image quality is stressed for all systems in Safety Code 35. In the relevant sections Health Canada’s advice is “the manufacturer’s recommended test procedures must be followed...” If manufacturers’ tests or phantoms are used by the manufacturers themselves or in-house staff, there must be quantifiable measurements which can be used to track performance. Otherwise the QC methods described in these documents should be used.

All CR systems can provide QC phantoms plus associated software designed for use in a QC program by the manufacturer. It is suggested that this approach be used for CR.

It is important that the manufacturers’ instructions be followed for dose calibration of the readers also, as all systems are calibrated at different beam filtrations.

Particularly important in these tests are:
- Use of a linear output processing function rather than the preprogrammed body part.
- Use of the correct filter in the x-ray beam.

All areas of image quality (Y11 to Y17) are measured except contrast (Y16). It is recommended that a Leeds CDR phantom or similar be used to provide a reference image.
**Dynamic range and Contrast Detectability (Y-13 and Y16-CR)**

Several methods can be used to document the contrast capability of a system. As contrast resolution depends on several factors, mainly the dose and the image processing algorithm, these must be kept constant for repeated or annual measurements.

**Dynamic Range**

Settings: 100 cm SDD; 70 kVp; CR cassette on tabletop; no grid; collimate to phantom; no AEC, and the 1 mm copper filter in place.

Determine the mAs required to give air kerma doses on the surface of the cassette of 1, 4, 12 and 50 microgray (This is the range of doses that the imaging plate will receive clinically).

Remove dose meter. Replace the used cassette with a recently erased CR cassette for each of the following exposures:

- a. 1 microgray
- b. 4 microgray
- c. 12 microgray

Read the cassettes and note the Exposure Index for each cassette. The exposure index, when converted to dose should be linear with the dose to the cassette (Y13 CR Dynamic Range).

Check the images for artifacts and uniformity.

**Contrast Detectability**

**Method 1 Leeds TOR CDR**

This is a simple phantom designed for CR or film-screen which can measure low contrast sensitivity, high contrast sensitivity and spatial resolution.

![Radiograph of the CDR phantom](image-url)
**Procedure**

Settings: 100 cm SDD; 70 kVp; CR cassette on tabletop; no grid; collimate to phantom; no AEC, and the 1 mm copper filter in place. Determine the mAs required to give air kerma doses on the surface of the cassette of 1, 4, 12 and 50 microgray (This is the range of doses that the imaging plate will receive clinically).

Remove dose meter. Replace the used cassette with a recently erased CR cassette and place the Leeds phantom in the centre of the light field for each of the following exposures:

- d. 1 microgray
- e. 4 microgray
- f. 12 microgray

Read the cassettes and note the Exposure Index for each cassette. View the images on a calibrated clinical workstation at 30 cm to determine the number of each size of object which can be fully discerned, and the smallest group of lines which can be discerned. Use the tables which come with TOR CDR to determine the contrast threshold for the 11 mm and 0.5 mm objects and the spatial resolution. The 5.6 mm disks give 10 grey scale steps. Automatic image analysis programs (PIAAA) are also available from Leeds Test Object to reduce the subjectivity of this test.

**Method 2 Artinis CDRAD Phantom**

The CDRAD phantom is a contrast-detail phantom made from Acrylic. 225 holes of different diameter and depth are arranged in a matrix on a sheet approximately 26x26x1 cm. Because of the number of contrast-detail objects involved the automatic analysis software CDRAD Analyser is recommended (www.artinis.com).
The CDRAD phantom

**Procedure**

The phantom can be used in many different ways. The suggested method described here tests the system over the range of clinical conditions.

**Equipment required:**

- Sheets of Acrylic 26x26 cm or greater to make a total thickness of 20 cm
- CDRAD phantom and CDRAD Analyser software
- PACS Connectivity or CDs/DVDs to record images for analysis
- Tape measure
- Dose meter
- Personnel dosimeter

![Position for Dosemeter](image)

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<td>CDRAD phantom</td>
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Place a freshly erased CR cassette in the Bucky, and ensure it is correctly aligned with the x-ray light field. Place 10 cm of Plexiglas on the table top, then the CDRAD phantom, then 10 cm more Plexiglas on top. Collimate the beam to the size of the phantom.

![CDRAD phantom sandwiched between two 10 cm slabs of acrylic](image)

Set up a standard supine AP Abdomen protocol at ~100 cm FDD. This will be a photo-timed procedure at about 80 kVp. Try to minimize the image pre-processing as recommended in the manufacturers’ test methods. This means removing any high frequency image processing and using a lookup table slope of 1.0. If this is not possible use the standard processing functions set for that protocol.

Note the kVp, mAs, SSD, AEC chambers used, any density corrections, and image processing factors. Make the exposure, process the image and note the Exposure Index. Annotate the image for future identification. Using exactly the same exposure factors (set mAs, no AEC), make an exposure with a solid state dose meter in the centre of the x-ray field, or with an ion chamber 30 cm above the phantom surface. Calculate surface dose by multiplying the surface air kerma by the backscatter factor.

The image will appear as below.
When analyzed with the software, the details which can be accurately visualized will appear red as shown above. The system will also give an Image Quality Index. Ensure you note all the exposure and setup information so the exposure can be accurately repeated at future sessions.

Repeat for 10 cm of acrylic plus the CDRAD phantom at PA Chest settings.

Note: The phantom surface dose measurement required in Y18 can also be made at this time by using the preset clinical AP Abdomen and PA Chest protocols.