Nuclear Associates 76-025

CDRH Dental Image Quality Test Tool

Instruction Manual

CardinalHealth

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Section 1

General Information

1.1 Introduction

The Dental Image Quality Test Tool was designed to provide a means of testing the functionality of dental x-ray units. The Dental Image Quality Test Tool consists of a phantom cradle that holds the evaluation phantom. The cradle has built-in slots for attenuation material. It also has an exposure chamber holder, a dental fog test tool and a mounting screw for connection to a tripod.

The Evaluation Phantom consists of four different copper wire mesh that have the following ratios: 100, 120, 150, and 200 lines per inch. It has four steps for contrast and density measurements. There is also a slot to fit intra-oral films.

The Dental Image Quality Test Tool comes with a Dental Fog Test Tool, which is designed for evaluating darkroom fog. This test tool is an aluminum step wedge that has a depression for exposing an intra-oral film packet and a two film slots for evaluating darkroom fog. Most dental x-ray equipment evaluation tests can be performed using this test tool.

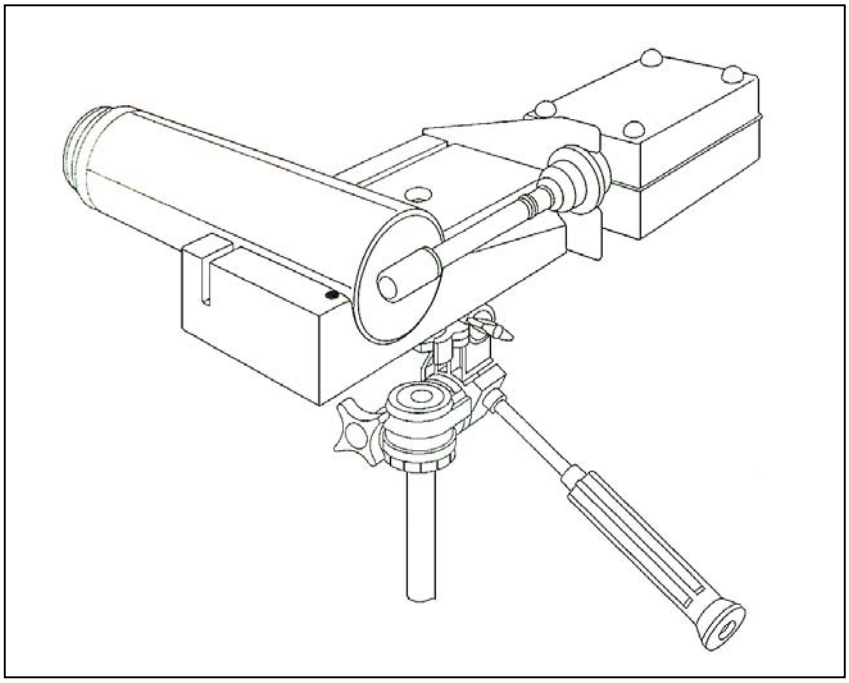

Figure 1-1. Dental Image Quality Test Tool

1.2 Setup Procedure

1. Place the Dental Image Quality Test Tool cradle on a support. The phantom cradle should be placed so that it is level and secure to avoid the possibility of a fall and damage. If a tripod is utilized, it can be attached to the underside of the phantom cradle using the tripod mounting screw.
2. The phantom cradle should be placed at a height that enables easy positioning of the intra-oral tube so that the cone lies level and parallel to the phantom cradle. The probe holder should be opposite from the cone.
3. Attach the exposure probe to the probe holder. It should be attached to the probe holder so that the sensitive volume of the chamber is centered in the x-ray field, as defined by the collimating cylinder (cone). The end or tip of the tube's cone should be placed in the phantom cradle so that the cone just makes contact with the probe, i.e., the center of the sensitive volume of the probe is at the tip of the cone.
4. If the cone is too short to make contact with the probe, reverse the setup of the cradle, making sure that the probe is still centered and parallel, and in contact with the cone.
5. Once you have aligned the probe and unit, do not move them. The intra-oral exposures will be made, using this setup.

Section 2

Operation

2.1 Darkroom Fog Measurement

The following procedure is used to sensitize a film for determining darkroom fog levels. You will need to use the darkroom fog test tool for this procedure. A 1.0 optical density of one of the fog test tool steps is needed, in order to evaluate fog. Because of this, two films may need to be taken.

1. Take the fog test tool, and invert it. A depression lies underneath the steps of the test tool. Place a packet of film in this depression, making sure that the tube side or flat side of the film packet is in contact with the test tool. Take the test tool, and turn it back over. The steps of the test tool should be facing upright toward the x-ray tube. Place the cone from the intra-oral unit down, so that it makes contact with the test tool. The cone should cover the steps of the test tool.
2. For the first film: Make an exposure using the facility's standard technique. Remove the film from the fog test tool, mark the film and place it in a shielded area.
3. For the second film: If needed, insert a new packet of film into the depression area of the fog test tool, and set up as you did previously. Use the same kVp but divide the mAs by ten, and take an exposure. Take this film, and place it with the other fog film.
4. In the darkroom, or the film-processing compartment, unwrap the previously exposed films from their packaging, and insert the films into the top slots of the test tool. The long side of the films should be inserted into the slots located on the left and right sides of the top of the test tool. The slots are located in the flat part of the test tool and not the step portion. *Be sure that you are bisecting the latent image.*
5. Position the films and test tool in an area of the darkroom, usually on the workbench, closest to a safelight. This should represent, in your opinion, an area where film is routinely handled and has the highest probability of safelight exposure.
6. Expose the uncovered half of the films to normal safelight conditions for two minutes. Make sure that you are not accidentally shielding the films from other potential fog sources, such as light leaks or digital light sources.
7. After two minutes have elapsed, quickly remove the films from the stepwedge, and feed them into the processor.
8. If a visible line appears down the center of the film, then you have a fogging problem. Using the densitometer, measure the densities of both the left and right sides of the film at various steps. Record the greatest density difference. Fog levels with a difference of less than 0.05 density units between unshielded and shielded film should be considered satisfactory for normal film handling times. Fog levels in excess of 0.05 can usually be reduced with minimal effort.

Fogging can either be attributed to improper bulb wattage, close safelight positioning, too many safelights, wrong safelight filters for the film processed, aged/damaged safelights, or any combination of these factors.

2.2 Phantom Image Evaluation

1. Insert one packet of the facility's film into the film holder, which is a "U"-shaped area located in the phantom bottom. The film holder is in close proximity to the wire mesh components of the phantom. Make sure that the tube side or flat side of the film packet is facing down in the direction of the wire mesh. (This is critical, since there is lead foil on the opposite side of the dental film. If the film is positioned incorrectly, the film density will be too light.)
2. After the film packet has been inserted, the phantom should be placed on the phantom cradle, so that the film packet is at the opposite end from the cone.
3. Move the phantom and cone into contact with each other. The cone should be aligned with the phantom and phantom cradle, and not be angled.
4. Utilizing the facility's standard technique settings for the facility's film, make an exposure.
5. Remove the film packet from the phantom, and develop the film. Measure the optical density. The optical density should be measured at the area adjacent to the low contrast object. Record the measurement.
6. Measure the densities of the three low contrast objects, and record those measurements.
7. Count the number of different gauge wire meshes that you can see, and record this number. You should not count a wire mesh pattern if you cannot see the tiny spaces that result from the mesh running both vertically and horizontally.

The results of these evaluation procedures should not deviate when re-evaluating the dental x-ray equipment in the future.

2.3 Technique Evaluation

1. Make an exposure, using the facility's standard technique, and record this reading.
2. Process the film.
3. Measure/compare the density against the reference/base value.

2.4 HVL Exposures

1. Slide the end of the cone away from the probe in the phantom cradle so that it is aligned to the edge of the filter slot. The cone tip should make contact with the aluminum.
2. In order to position the dental cone, first insert a thickness of aluminum into the slot, and bring the cone tip as close to the aluminum as possible.
3. Remove the aluminum, and make an exposure. Record the output for 0.0 mm added aluminum.
4. Insert 1.0 mm of aluminum in the slot of the phantom cradle. Be sure the filter is aligned with the probe so that the probe is completely within the filtered x-ray beam. Make a second exposure. Record the total thickness of added aluminum in mm and the output in mR.
5. Repeat Step 4 until the last exposure is less than half of the 0.0 mm added aluminum measurement. Record all of the exposures and added aluminum (filter thicknesses).
6. Determine the HVL to the nearest tenth of a millimeter of aluminum by drawing the best straight line fit to all but the first (0.0 mm Al) data points. By plotting the exposure versus the aluminum thickness used, find the point on the line where the exposure is half that of the 0.0 mm Al exposure. The thickness of Al corresponding to this point is the HVL.

2.5 kVp Determination by Copper Transmission Method

1. Use the same setup as you did for the HVL determination.
2. Select a technique that gives you exposure readings that are greater than 10 mR with both thicknesses of copper in the beam (approx. 0.76 mm). The facility's standard technique may be a good place to start.

   Make the exposures with the facility's standard technique. If it is not able to produce exposure values greater than 10mR, then increase the mA and time or mAs settings. *Do not change the kVp setting.*

NOTE

The kVp setting should not differ from the facility's standard technique. Do not round off your exposure readings.

3. Insert both copper filters in the slot of the phantom cradle. Be sure the filters are centered to the probe, and make an exposure. Record the total thickness of the copper filters in mm and the output in mR. Record the average of the three exposures and the respective thicknesses.
4. Decrease the total thickness of copper filtration by removing the 0.25 mm thickness of copper. Make three exposures. Record the average of the three exposures in mR.
5. Determine the ratio of the two average exposure values for the two different copper filters (0.76 mm Cu: 0.51mm Cu). The answer must have a value less than 1.00.
6. Using a kVp chart, find the copper transmission ratio value along the y-axis. To find the kVp, trace a line horizontally from the point along the y-axis, and determine where it intersects with the existing line plotted on the chart. After the intersection has been determined, trace a line straight down to the x-axis to get the corresponding kVp value.

NOTE

If the ratio is less than 0.359, indicate the kVp as 54.0. If the ratio is greater than 0.657, indicate the kVp as 96.0. The copper transmission ratio method for kVp determination will not work for kVps outside the range of 55 to 95 kVp.

Radiation Management Services

For additional information, please contact Radiation Management Services business of Cardinal Health at 440.248.9300, or 516.870.0100

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