Name: ________________________________ Date: ________________ Team: _____

Lab Experiment # 3

Automatic Exposure Control System
and
Dose Area Product 2

Direct Radiography

Purpose

This experiment is designed to demonstrate the proper use of automatic exposure control (AEC) systems as well as the influence of different technical factors on dose area product.

Learning Objectives

After completing this lab, you should be able to:

1. Use the laboratory equipment properly.
2. Set up the control console and ceiling tube mount correctly.
3. Function effectively in group work.
4. Perform the experiment independently.
5. Set up the control console or an automatic exposure control system.
6. Explain the common limitations of AEC.
7. Predict the effect of the change in SID, OID, IR speed class, collimation, and density setting on the exposure index and dose area product (DAP).

Materials Needed

- **35cm x 43 cm FPD image receptor**
- **Knee - phantom**
- Set of radiopaque markers

Pre-Lab Discussion

AEC Systems

The primary limitation when manually setting the exposure factors for an examination is that the radiographer only determines the radiation in the primary beam/signal. An unknown amount of absorption and scattering takes place as the radiation passes through the object; so, ***the intensity of the image-forming radiation in the exit beam is different for each examination***.

An AEC system works on a very simple assumption to overcome this problem. When the correct amount of radiation reaches a specific area of the image receptor an optimum exposure will be produced for the entire image receptor.

Automatic exposure control systems contain special, highly sophisticated radiation detectors that measure the quantity of radiation reaching the image receptor **as the exposure is taking place**; once a pre-set amount that corresponds to optimal density is reached, the systems shut off the x-ray timer, thereby terminating the radiation.

This is analogous to baking a turkey in the oven after inserting a pop-up timer into the breast of the chicken. When the temperature of that specific area of the breast is correct, the timer pops up to indicate the entire chicken is done. The assumption is that when that area has reached the correct temperature, the entire chicken has reached the correct temperature.

Consequently, when the **dominant area** of an image receptor has received the pre-set amount of radiation that corresponds to optimum exposure, the entire image receptor has received the correct amount of radiation; so, the ***exposure*** will generate optimum diagnostic quality image.

A **dominant area** is not the most dense or least dense; it ***is any area of the object that, when properly exposed, will ensure that the entire object will be properly exposed***.

Precise alignment of the dominant area of the anatomic part and the active radiation detector(s) is critical when using AEC systems. They can only guarantee an optimum exposure for structures positioned **in front of** the active detector(s).

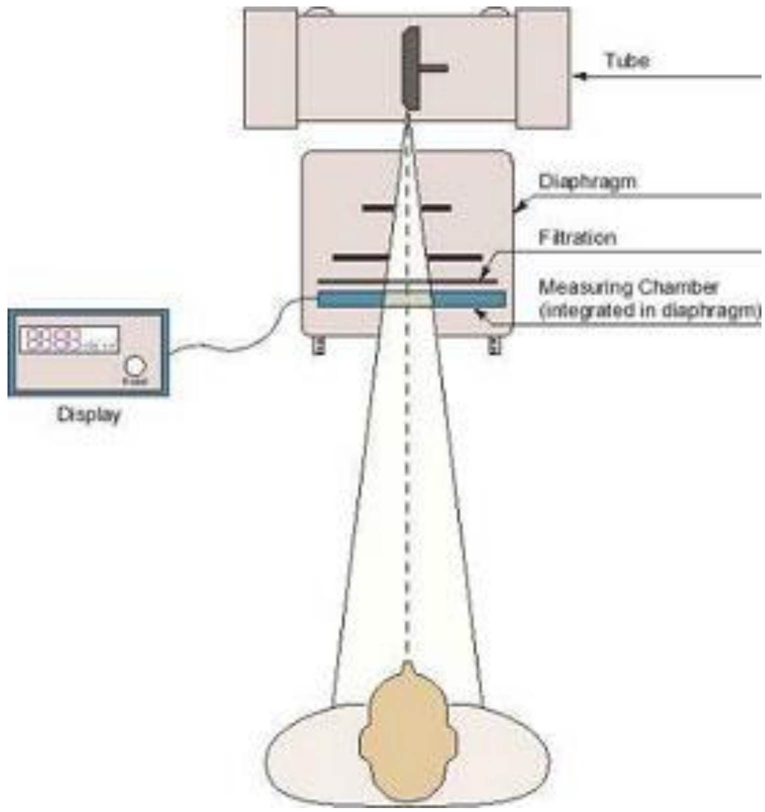
The radiographer does not control exposure time. The AEC system controls the exposure time, and as a result, the mAs used for each examination. All other factors may be set manually.

With many of the newer digital imaging systems, when the radiographer sets the body part and position, ***the AEC automatically selects the radiation detectors for the dominant area(s), optimum kilovoltage for penetration, mA station, and default back-up time for the exam***.

Dose area product (DAP) is a quantity used in assessing the radiation risk from diagnostic X-ray examinations and interventional procedures.

DAP-meters measure the product of radiation dose to air and the area of the X-ray field. DAP is expressed in cGy.cm^2 or mGy.cm^2. An ionization chamber larger than the area of the X-ray beam is placed just under the X ray collimators. The DAP ionization chamber must intercept the entire X-ray field for an accurate reading; this quantity is proportional to EAP. The reading from a

DAP-meter can be changed by either altering the X-ray technique factors (kVp, mAs or time), or varying the area of the field or both.



Maintaining or adjusting exposure to the IR can be accomplished with kVp by using the 15% rule. The 15% rule states that changing the kVp by 15% has the same effect as doubling the mAs, or reducing the mAs by 50%. Increasing the kVp by 15% and reducing mAs by half maintains the exposure to an image receptor but reduces the dose area product (patient dose).

Experimental Setup

Instructions for Exposure 1-15

1. Place a direct radiography FPD image receptor in the **bucky lengthwise** and set the SID to 40 inches.
2. Place the **natural bone knee** on the tabletop positioned for an **AP knee** projection with its long axis **parallel** to the long axis of the table.
3. Direct the central ray **perpendicular** at the level ½ inch inferior to the patellar apex and collimate to leave a **two inch border of radiation on both sides of the knee** to allow room for your radiopaque ID markers to show on the image.
4. Tape the appropriate ID markers onto the tabletop within the collimated light field so they do not obscure any areas of interest.
   (The room, side and exposure number must be labeled on **all** radiographs.)
5. Set the control console to the **AEC** mode.
6. Make exposer **1-15** using the settings indicated on the worksheet.
7. Record the mAs, time, and DAP for each exposure. mAs will be displayed on the control console **immediately after each exposure has been completed**. DAP can be found in the log file of the unit.
8. Record the TEI, EI, and DI for each exposure.

Technique Worksheet

Direct Radiography

The wireless digital (FPD) image receptor can only be handled by an instructor!

	Speed class	kV	FSS	Back-Up Time	Radiation Detectors	Density Selector	Grid	SID	mAs	collimation	DAP cGy cm^2	EI TEI DI
1	?	84	small			0	bucky	40”		**10X12**		
2		84	small			0	bucky	25”		**10X12**		
3		84	small			0	bucky	50”		**10X12**		
4		84	small			0	bucky	40”		**10X12**		
5		84	small			0	bucky	40”		**8 x10**		
6		84	small			0	bucky	40”		**5x5**		
7	M	84	small			0	bucky	40”		**10X12**		
8	L	84	small			0	bucky	40”		**10X12**		
9	H	84	small			0	bucky	40”		**10X12**		

10		84	small			0	bucky	40”		**10X12**		
11		84	small			+5	bucky	40”		**10X12**		
12		84	small			-5	bucky	40”		**10X12**		

	Speed class	kV	FSS	Back-Up Time	Radiation Detectors	Density Selector	Grid	SID	OID	mAs	collimation	DAP	EI TEI DI
13		84	small			0	bucky	40”	4”		**10X 12**		
14		84	small			0	bucky	40”	8”		**10X 12**		
15		84	small			0	bucky	40”	16”		**10X 12**		

Worksheet

1 – 3	Is the EI increasing from exposure 1 to 3? Is the patient dose increasing from exposure 1 to 3?	

4 – 6	Is the EI decreasing from exposure 4 to 6? Is the patient dose increasing from exposure 4 to 6?	

7 – 9	Is the EI decreasing from exposure 7 to 9? Is the patient dose increasing from exposure 7 to 9?	

10 – 12	Is the EI decreasing from exposure 10 to 12? Is the patient dose increasing from exposure 10 to 12?	

13 – 15	Is the EI decreasing from exposure 13 to 15? Is the patient dose increasing from exposure 13 to 15?	