



DEPARTMENT OF HEALTH  
DIRECTORATE: RADIATION CONTROL



## GUIDELINES

### MINIMUM REQUIREMENTS FOR FIXED DIAGNOSTIC X-RAY INSTALLATIONS

(Not applicable to mobile units)

#### 1. HIGH-TENSION GENERATOR

##### 1.1. Electric power rating

1.1.1. The minimum acceptable power rating is:-

1.1.1.1. High frequency generators: 12 kW at 100 kV (The high-tension voltage ripple shall be no larger than 4%, measured at 100 kV (kVp) and 100 mA).

1.1.1.2. Three phase, 12-pulse **or** constant potential generators: 12 kW at 100 kV.

1.1.1.3. Three phase, 6 pulse generators: 16 kW at 100 kV.

1.1.1.4. Single phase generators: 24 kW at 100 kV.

**Note: An imaging system of at least a 400 speed should be incorporated in the above-mentioned systems.**

##### 1.2. Nominal X-ray tube voltage

The nominal X-ray tube voltage (highest available kV) shall be at least 120 kV.

##### 1.3. Exposure time

1.3.1. Values of exposure time need not be displayed.

1.3.2. The shortest **reproducible exposure time** (measured as the time during which the kV is 75% of the selected value) shall be 5 ms or shorter.

1.3.3. The shortest (total) **exposure time** shall be equal to or less than 10 ms.

1.3.4. The maximum exposure time should not be longer than 2.5 s.

##### 1.4. Electric energy rating

1.4.1. The maximum nominal electric energy (total available energy for one single exposure), measured at 100 kV and a tube loading time not exceeding 2.5 s, shall be at least:

1.1.1.5. 25 kW for high frequency, three phase (12 pulse) and constant potential generators;

1.1.1.6. 33 kW for three phase (6 pulse) generators;

1.1.1.7. 50 kW for single phase generators.

### **1.5. Generator control panel**

The following switches or controls shall be available:

1.5.1. ON / OF

1.5.2. kV-selector

1.5.3. mAs-selector or mA and time-selector

1.5.4. Anode rotation

1.5.5. Exposure. The exposure switch should be mounted on the control panel, so that the operator must stand behind a protective screen or wall during exposures.

1.5.6. A light signal shall indicate if the generator is READY for the selected tube loading. The actual tube loading (exposure) shall be indicated with a sound and/or a light signal.

## **2. THE X-RAY TUBE**

### **2.1. Focal spot**

2.1.1. A rotating anode must be used.

2.1.2. The focal spot of the X-ray tube shall have a nominal size **no larger than 1 mm**, measured according to IEC 336.

2.1.3. For dual focus at least one focus to be a maximum of 1 mm.

### **2.2. Anode**

The anode angle shall be in the range of 12 - 15°. (An anode angle of 12° easily permits an X-ray field of 45 x 45 cm without visible heel effect at the expected working conditions.)

### **2.3. Tube rating**

Tube rating shall be compatible with the X-ray generator.

### **2.4. Tube filtration**

2.4.1. Minimum total filtration for three phase (6 & 12 pulse),  
constant potential, and high frequency: 2.5 mmAl

2.4.2. Minimum total filtration for single phase: 3.5 mmAl

## **2.5. Collimator**

- 2.5.1. To be multi-leaf and manually operated with full field illumination.
- 2.5.2. X-ray / light field coincidence to be within 2 cm on the 43 cm x 43 cm field at 100 cm.
- 2.5.3. A rotating flange between the collimator and the tube must be supplied to provide diagonal collimation.

## **3. TUBE ASSEMBLY (U-ARM)**

- 3.1. It is necessary to use a design which will ensure that the X-ray tube can always be aligned with the cassette holder in a rigid and stable way, i.e. providing precise and simple centering of the X-ray beam.
- 3.2. The X-ray tube and cassette holder shall be mounted in such a way that a recumbent patient can also be examined with a horizontal X-ray beam.
- 3.3. A gauge shall be installed to indicate tube assembly rotation (degrees).
- 3.4. Devices shall be installed to indicate the focus-film distance.
- 3.5. Brakes for tube assembly:            Mechanical and/or electromagnetic.
- 3.6. Variable focus-film distance (fixed not acceptable):    1000 mm – 1500 mm
- 3.7. Height above floor for horizontal beam:
  - minimum height of 500 mm or less
  - maximum height at least 1600 mm
- 3.8. Tube/cassette-holder arm angulation from vertical and horizontal position:  $\pm 30^\circ$

## **4. TUBE ASSEMBLY (TUBE COLUMN WITH TABLE AND ERECT BUCKY)**

- 4.1. A moving floor-to-ceiling / wall mounted or rail system tube column is required.
- 4.2. It is necessary to use a design which will ensure that the X-ray tube can always be aligned with the cassette holder in a rigid and stable way, i.e., providing precise and simple centering of the X-ray beam.

- 4.3. The X-ray tube and cassette holder shall be mounted in such a way that a recumbent patient can also be examined with a horizontal X-ray beam.
- 4.4. The longitudinal movement of the tube column to be at least 150 cm. FFD from erect Bucky to be at least 150 cm. It shall also be possible to use a FFD of 100 cm on the erect Bucky.
- 4.5. The FFD must be indicated on the table Bucky as well as erect Bucky.
- 4.6. A gauge shall be installed to indicate tube assembly rotation (degrees).
- 4.7. Rotation of the tube arm around its horizontal axis to be at least from  $-90^{\circ}$  to  $+90^{\circ}$ .
- 4.8. Rotation of the tube arm around its vertical axis to be at least from  $-90^{\circ}$  to  $+90^{\circ}$ .
- 4.9. Rotation of the tube around its own axis to be at least from  $-10^{\circ}$  to  $+10^{\circ}$ .
- 4.10. Vertical movement of the tube arm to be at least 150 cm from the table top.
- 4.11. The centre of the horizontal beam must be aligned with the centre of the erect Bucky for the entire movement of the Bucky.
- 4.12. Brakes for tube assembly: Mechanical and/or electromagnetic.

## 5. BUCKY TABLE

### 5.1. Floating-top table

- 5.1.1. The table top shall be able to support a patient weighing at least 110 kg, sitting in the middle of the table, without appreciable distortion.
- 5.1.2. The equivalent density of the tabletop should not be more than 1.5 mm Al.
- 5.1.3. Minimum table width: 650 mm
- 5.1.4. Minimum table length: 2000 mm
- 5.1.5. Minimum table height (table-top to floor): 700 mm
- 5.1.6. Longitudinal movement: at least  $-600$  mm to  $+600$  mm
- 5.1.7. Lateral movement: at least  $-120$  mm to  $+120$  mm
- 5.1.8. Centre lock must be available.
- 5.1.9. Brakes for table movement: **Electromagnetic**.
- 5.1.10. The distance between the table top and film plane shall not exceed 80 mm.

### 5.2. Trolley

- 5.2.1. The examination table shall be a trolley if and only if a U-arm is comprised in the system. .
- 5.2.2. The trolley shall at least be able to support a patient weighing 110 kg, sitting in the middle of the table, without appreciable distortion.
- 5.2.3. The equivalent density of the top should not be more than 1.0 mm Al.
- 5.2.4. The design of the trolley must permit the use of the cassette holder in horizontal position under the trolley in such a way that the distance between the top of the trolley and the film plane shall not exceed 80 mm. In this position it must be possible to use the trolley as a floating-top table, so that the longitudinal midline of the trolley can be offset  $-120$  mm to  $+120$  mm or more from the midline of the cassette holder.
- 5.2.5. The trolley shall have large wheels with locks on at least two of them.
- 5.2.6. Dimensions:-

‡	Minimum trolley width:	650 mm
‡	Minimum trolley length:	2000 mm
‡	Minimum trolley height:	700 mm
‡	Minimum diameter of wheels:	100 mm

## 6. ERECT BUCKY

- 6.1.1. Wall / floor mounted stand.
- 6.1.2. Vertical movement from  $\pm 750$  mm to  $\pm 1800$  mm from floor.
- 6.1.3. Cassette tray for standard sizes 130 mm x 180 mm to 350 mm x 430 mm.

## 7. ANTI-SCATTER GRID

Focussed anti-scatter grid(s) must be supplied. The grid ratio shall be 10:1 with a line density of 35-60 lines/cm. The grid shall be large enough to cover a vertical film format of 35 cm x 43 cm. If the 35 cm x 43 cm format will be used in transversal position, the grid must be 43 cm x 43 cm. The focal range for the grids in the erect as well as table Bucky shall be such that chest radiography with an FFD of 150 cm and general radiography with an FFD of 100 cm can be done.

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