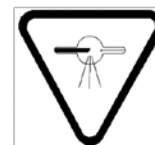


University of Ottawa  
Office of Risk Management  
**X-RAY EMITTING DEVICE (XED) INSPECTION CHECKLIST**



The following inspection checklist is based on the requirements of the Ontario Occupational Health and Safety Act R.R.O 1990, Regulation 861 (X-Ray Safety). The subsections in the Act are indicated in questionnaire, where applicable. Other regulations may be indicated. An SOP for radiation surveying is given on the last page.

**Permit Information**

Permit Number	
Permit Holder	
Faculty	
Department	

**XED Information**

Manufacturer	
Model	
Serial	
Source (Energy)	

**Inspection Information**

Operating Voltage (kV)	
Operating Current (mA)	
Inspector	S.E. Kirkwood
Date	
Accompanied by	

**Survey Meter Information**

Meter and Detector	RadEye B20 w/o filter
Calibration Date	March 13, 2013
Background Count Rate	

\* see X-Ray Detection document (2013/8/28) regarding rationale on units of measurement and devices

**1 Gy/h = 1 Sv/h (for photons: X-Rays)**

Item	Issue	Y/N	Comment
<b>A. REGISTRATION OF X-RAY EMITTING DEVICE</b>			
1.0	XED has been <b>registered</b> with Ministry of Labour (MOL) (s.5(1))		<i>Original Registration Date:</i>
2.0	Based on original registration (s.6(6)): a) has the <b>installation and use changed?</b> (s.6(7a))		
	b) has use of <b>rooms or areas adjacent</b> , horizontally and vertically, <b>changed?</b> (s.6(7b))		
	c) has <b>shielding</b> of x-ray source <b>changed?</b> (s.6(7c))		
	d) has any <b>modification</b> to system arrangement changed (filtration, specimen chamber, collimators, beam ports), or has <b>major maintenance</b> and <b>relocation</b> of the device been made since last registration? (CSC 32 (3.3.1.1))		
3.0	XED has been <b>disposed</b> of or <b>transferred off</b> university property (s.5(4)) <i>- If yes, date of disposal or transfer</i>		
4.0	XED has been <b>decommissioned</b> , Environmental Health and Safety Service (EHSS) notified, MOL informed		
<b>B. USERS AND TRAINING</b>			
5.0	a) <b>X-ray Users:</b> - have <b>training</b> (theoretical and practical) for safe operation of XED (s.8) - have been <b>informed</b> of the characteristics, risk and safe practices (s.8) - <b>documentation</b> (SOP & Safety Code) available (CSC 32 (3.4.1))		
	b) <b>X-ray Workers*:</b> - have <b>training</b> (theoretical and practical) for safe operation of XED (s.8) - have been <b>informed</b> of the characteristics, risk and safe practices (s.8) - <b>documentation</b> (SOP & Safety Code) available (CSC 32 (3.4.1)) - are <b>informed in writing</b> of their designation and dose limit (s.9(1a,b))		
6.0	All users and workers are <b>informed</b> of the <b>applicable dose limits</b> (s.9(1b))		
7.0	<b>Pregnant users</b> and workers are <b>informed</b> of the <b>dose limits</b> which apply (s.9(1c))		

C. SIGNAGE / WARNING LIGHTS			
8.0	Appropriate X-ray <b>warning signs and devices posted</b> conspicuously (map location correct), contact names referenced (s.11(1) and CSC 32 (3.3))		
9.0	<b>uOttawa XED Permit posted</b> near XED or within laboratory		
D. GENERAL SAFETY FEATURES & PROCEDURES (s.11)			
10.0	XED generating an air kerma of greater than <b>5 <math>\mu\text{Gy/h}</math></b> must be <b>labeled at control panel</b> as an X-ray source (s.11(2)) <i>- Reading kV, mA meter, lock or key meter</i>		
11.0	Where the air kerma <b>in an area</b> exceeds <b>100 <math>\mu\text{Gy/h}</math></b> , locks and interlocks are used (portable XED have barriers and signs) (s.11(3))		
12.0	<b>Shielding, diaphragms, cones, and adjustable collimators</b> or other suitable devices ensure dose limits are not exceeded (s.11(4))		
13.0	<b>Access restricted</b> to trained, registered and authorized personnel (CSC 32(3.3))		
14.0	Survey meter (calibrated and functioning) available during operation of XED (CSC 32 (3.4.1))		
15.0	Radiation survey report (exposure rates) in all adjacent rooms and operator's position		
E. DOSIMETRY (s.12)			
16.0	X-ray workers and users are familiar with the basic principles of radiation safety and the "As Low As Reasonably Achievable" ( <b>ALARA</b> ) principle is practiced		
17.0	<b>Dose limits</b> are not exceeded		
18.0	<b>Dosimeter badges</b> are worn appropriately, if required, and stored in an appropriate location		
19.0	Any <b>dose which is not reasonable</b> is reviewed and if necessary MOL informed		
20.0	All <b>dosimetry records</b> are kept for 3 years		
F. REPORTING ACCIDENT / INCIDENTS (s.13 and s.14)			
21.0	<b>Accident / incident</b> resulting in a possible exposure exceeding regulatory limits is reported immediately (Occupational Health Disability and Leave (OHDL), Protection Services (PS))		
G. XED			
22.0	X-ray source, object to be exposed to X-rays, and detection devices enclosed in a cabinet	Yes	Complete Section H
23.0	Analytic X-ray device where question 22.0 was answered 'No'	No	Complete Section I
24.0	X-Ray machine is used for diagnostic examination of animals	No	Complete Section J
H. CABINET XED (s.17)			
25.0	<b>Warning device</b> mounted conspicuously on cabinet from any position from which it can be opened (s.17(1))		
26.0	<b>Door and ports interlocked</b> with source or shielded shutter of failsafe design where operation may only resume from control panel once interlock is reset (s.17(2)) <i>- Is it functioning?</i>		
27.0	<b>Cabinet</b> arranged and shielded to prevent air kerma rate from exceeding <b>5 <math>\mu\text{Gy/h}</math></b> at any accessible point 5 cm from any external surface, under all possible operating conditions (s.17(3))		
28.0	Cabinet permits <b>entry of a person</b> and has appropriate safety controls (s.17(4))		
I. ANALYTIC X-RAY DEVICE (NOT IN CABINET)			
29.0	<b>Indicators and warning lights</b> near control panel and tubes indicating when X-rays are produced		
30.0	The <b>shutter position</b> (open / closed) is clearly indicated at or near the x-ray tube <i>- is this a fail-safe design?</i>		
31.0	Each <b>port designed</b> such that the <b>x-ray beam can emerge</b> only when a camera or other <b>recording device is in its proper position</b> (whenever practical) <i>- is this a fail-safe design?</i>		
32.0	A <b>guard or interlock</b> is used to prevent entry of any part of the body into the primary beam path (wherever practical) <i>- Does it working as intended?</i>		
33.0	A <b>shield absorbs the primary beam</b> at the nearest practical position beyond the point of intersection of the beam and the irradiated sample		
34.0	All <b>unused ports are secured</b> to prevent inadvertent opening		

J. DIAGNOSTIC EXAMINATION OF ANIMALS (s.16)		
35.0	Radiographic procedures shall be performed <b>in a room designed</b> for the purpose of performing x-ray examinations of animals, if applicable	
36.0	<b>Air kerma due to leakage radiation</b> from X-ray tube housing or attached beam limiting device < <b>1 mGy/h</b> at 1 m from focal spot of the X-ray tube	
37.0	Exposure duration controlled by a <b>preset timing mechanism</b> and is initiated by a switch that requires positive action by the operator to continue the exposure and that allows the operator to remain at least 2 m from the tube housing	
38.0	The <b>dimension of the useful beam</b> limited to that of the film (whenever possible)	
39.0	The <b>film cassette</b> is not held by hand during exposure	
40.0	<b>Animal</b> being X-rayed is <b>restrained or supported</b> by mechanical means (where practicable)	
41.0	<b>Protective aprons and gloves</b> (providing shielding equivalent to at least 0.5 mm of lead) worn by person providing restraint or support by hand to X-rayed animal	
42.0	<b>Records of radiographic exposures</b> , (with date, tube voltage and current, and each exposure duration) kept for at least one year	

*\*A worker who may receive a dose equivalent in excess of the annual limits set forth in Column 4 of the Schedule*

#### **X-Ray Radiation Survey: Standard Operating Procedure**

A pancake GM meter is sufficient to detect the presence of X-ray radiation for the energy ranges used on campus. A pancake or end-window GM detector is ideal since it keeps your hands away from possible X-ray beams. **Use a meter calibrated and capable of measuring mR/h,  $\mu$ Gy/h, or  $\mu$ Sv/h; do not use a meter that registers only cpm or cps (unless it is being used to compare the machine's leakage to the background level).**

1. If necessary, load batteries into the meter and then check the battery level.
2. If possible, perform a source check (some Ludlum meters have sources on the side)
3. Take a background radiation measurement before entering the X-ray room and record the value in the **Survey Meter Information** table (preferably in  $\mu$ Gy/h).
4. Ensure the XED is operating in its nominal operating condition (kV, mA) as indicated in the **Inspection Information** table.
5. Ensure the device is set to its nominal operating condition (at a range to measure 5  $\mu$ Gy/h; or 0.5 mR/h if the units of  $\mu$ Gy/h is not available). For example, the 10X scale on a Ludlum Model 12.
  - a. **For the RadEye B20:** for photon energies at and above 17 keV, attach the H\*(10) filter and place the meter in the Gy/h setting; if below 17 keV, use the bare face and set the meter to cps. **Use these units on this form.**
6. For a cabinet XED, survey at a distance of 5 cm from the surface at any position along the XED, but especially at doors and shield positions.
7. Enter the actual reading in section 27.0; do not use qualifying statements such as "At background".
  - a. If a significant **reading above the background** is measured (approx. 2x), then leakage of X-rays may be likely. Record this value and the approximate location on the instrument of this reading in section 27.0 instead.
  - b. If the survey **meter is not calibrated** for the energy range listed in the **XED Information** table (for example, 8 keV), a quantitative measurement with a detector calibrated for this radiation energy is required **if leakage is detected** (for example, a pressurized ionization chamber).



**Links to X-ray Safety and Regulatory Code:**

1. [Occupational Health & Safety Act RRO 1990, Regulation 861, X-ray Safety, Ontario Ministry of Labor](#)
2. [Health Canada Safety Code 32 - Safety Requirements And Guidance For Analytical X-ray Equipment \(CSC 32\)](#)
3. [Health Canada Safety Code 34 - Radiation Protection and Safety for Industrial X-Ray Equipment](#)
4. [Analytical X-ray Safety Training Tutorial - University of Illinois](#)
5. [Analytical X-ray Safety Manual - University of California, Davis](#)