

# University of Pennsylvania

## Environmental Health and Radiation Safety (EHRS)

# Hand-Held X-ray Fluorescence Device User Guide

*(Reviewed: May 2013)*

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## **I. INTRODUCTION**

Hand-held x-ray fluorescence devices are mobile devices that utilize x-rays to determine elemental or chemical composition, or to examine the microstructure of a material through the use of x-ray fluorescence.

## **II. PA DEPARTMENT OF ENVIRONMENTAL PROTECTION**

Use of x-ray equipment in Pennsylvania is regulated by the PA Department of Environmental Protection (DEP). The DEP has established regulations which must be followed by all individuals using energized (x-ray) equipment. These regulations are found in Title 25 Chapters 219, 220, and 227 of the Pennsylvania Code and are available for review in the Environmental Health and Radiation Safety (EHRS) office, or on the DEP website at <http://www.pacode.com/index.html>.

## **III. ENVIRONMENTAL HEALTH AND RADIATION SAFETY (EHRS)**

EHRS is responsible for ensuring that radiation and radioactive material is used safely at Penn and associated facilities (e.g., Wistar Institute, CHOP). EHRS staff performs a safety check of each diffraction x-ray unit at installation and annually (at a minimum). If service is provided on the unit that would effect the arrangement, number, or type of components in the system contact EHRS for an additional safety check prior to use. [PA 227.12a]

## **IV. X-RAY DIFFRACTION UNITS**

### **A. Unit Registration**

All analytical energized equipment must be registered with EHRS prior to use. This can be done by contacting EHRS, and must be done at the time of equipment installation. [PA 219.131-2]

### **B. Unit Acquisition**

It is the responsibility of the clinical personnel to notify EHRS upon acquisition of any new x-ray equipment. Authorized EHRS personnel will conduct a radiation safety survey on all new units prior to use.

### **C. Unit Relocation, Disposal, or Transfer**

EHRS must be notified prior to relocation, disposal, or transfer of ownership of x-ray equipment. EHRS will ensure that proper notifications to State Agencies are made. [PA 219.131-2]

## **V. WORKER RESPONSIBILITIES**

### **A. Worker Training [PA 227.14]**

Persons operating this equipment must receive instructions in the safe use of this equipment, including:

- a. Significance of the various radiation warning and safety devices incorporated into the equipment, or the reason they have not been installed on certain pieces of equipment, and the extra precautions necessary if the devices are absent or bypassed.
- b. Operating and emergency procedures.

## **VI. RADIATION SURVEY**

All x-ray fluorescence equipment must be surveyed at the following times [PA227.11a]:

1. Upon installation;
2. Annually;
3. Whenever the following occurs:
  - a. Following maintenance requiring the disassembly of the system.
  - b. When a visual inspection of the system reveals an abnormal condition.
  - c. When the machine is operated in a manner other than the routine manner specified in the operating procedures.

## **VII. SAFETY DEVICES AND SIGNS**

- 1 Safety Interlocks may include:
  - a. Mechanical switches which require the device to be pressed against the sample or sample holder prior to x-ray production.
  - b. Infra-red proximity sensors which prohibit x-ray production unless a sample is in place.
  - c. X-ray backscatter detection system to halt operation of the x-rays in the event that no backscattered x-rays are seen by the system.
- 2 An easily visible warning indicator must be present which does the following [PA 227.11a.(d)]:
  - a. Illuminates when the X-ray tube is energized and labeled with the words "X-Ray ON."

## **VIII. OPERATING REQUIREMENTS**

Operating procedures must be written and available to the analytical x-ray equipment operators.

An individual may not operate analytical x-ray equipment in a manner other than that specified in the operating procedures unless that individual has obtained written approval from the EHRS Radiation Safety Officer (RSO). Except when written approval is given by the RSO to override safety devices, operations involving removal of covers, shielding materials or tube housings, or modifications to shutters, collimators or beam stops may not be performed without ascertaining that the tube is off and will remain off until safe conditions have been restored.

## **IX. OVERRIDING SAFETY DEVICES**

An individual may not bypass or otherwise circumvent a safety device unless that person has received prior written approval from the RSO. An approval request form can be found on the EHRS website at <https://www.ehrs.upenn.edu/policies-resources/request-interlock-override-approval-x-ray-diffraction-units>. [PA 227.13a(b)]

## **X. PERSONNEL EXPOSURE MONITORING**

Exposure to scattered radiation from x-ray fluorescence x-ray equipment is extremely low. For routine  
  
However, personnel dosimetry may be required if there experimental setup may require an air gap between the end of the x-ray fluorescence unit and the sample. Contact EHRS for dosimeters prior to such procedures.

## **XI. EMERGENCY PROCEDURES**

If anyone thinks they may have been exposed to the direct x-ray beam, please contact EHRS immediately. EHRS is required to report suspected overexposures to the DEP within 5 days of the incident, so ***immediate action is required*** by anyone suspecting that they have been exposed to the x-ray beam. [PA 227.14(2)(d)]

## **XII. IMPORTANT PHONE NUMBERS**

University of Pennsylvania, Environmental Health and Radiation Safety:

Monday – Friday during business hours **(215) 898-7187**

On-Call Physicist for assistance after hours **(215) 573-6626**