

UAH

University of Alabama in Huntsville

X-RAY DIFFRACTION USER GUIDE

Office of Environmental Health and Safety
Facilities and Operations Department
The University of Alabama in Huntsville
Huntsville, AL 35899

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I. INTRODUCTION

Analytical X-ray machines are defined as an assembly of components that utilize x-rays to determine elemental or chemical composition, or to examine the microstructure of a material through the use of x-ray diffraction or fluorescence.

II. ALABAMA DEPARTMENT OF PUBLIC HEALTH

Use of x-ray equipment in Alabama is regulated by the AL Department of Public Health (ADPH). The ADPH has established regulations which must be followed by all individuals using energized (x-ray) equipment. These regulations are found in Chapters 420-3-26-.11 and are available for review in the Office of Environmental Health and Safety (OEHS), or on the ADPH website at <http://www.adph.org/administration/Default.asp?id=498> (select Radiation Rules).

III. RADIATION SAFETY OFFICER (RSO)

The RSO is responsible for ensuring that radiation and radioactive material is used safely at UAH. The RSO 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 affect the arrangement, number, or type of components in the system the RSO must be contacted immediately for an additional safety check prior to use.

IV. X-RAY EQUIPMENT

A. Equipment Registration

All analytical X-Ray producing equipment must be registered with the OEHS prior to use. This can be done by contacting OEHS, and must be done prior to installation.

B. Unit Acquisition

It is the responsibility of the personnel to notify OEHS upon acquisition of any new x-ray equipment. The OEHS will contact the RSO. When applicable the RSO will conduct a radiation safety survey on all new units prior to use.

C. Unit Relocation, Disposal, or Transfer

OEHS must be notified prior to relocation, disposal, or transfer of ownership of x-ray equipment. Relocation includes moving equipment to a different room within the same building. OEHS will ensure that proper notification to the RSO is made.

V. WORKER RESPONSIBILITIES

A. Worker Training

1. Radiation Safety Training

All persons using x-ray diffraction equipment must complete the Radiation Fundamentals and Radiation Safety training provided in PowerPoint format at

<https://www.uah.edu/oehs/available-safety-training>.

The receipt of training verification must be provided to the supervisor prior to working on the equipment. The OEHS will provide training documentation upon request.

2. Operational Training

Additionally, all persons operating the equipment must receive the following instructions from the primary researcher and demonstrate competence in the following areas:

- 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 diffraction equipment must be surveyed at the following times:

1. Upon installation;
2. Annually;
3. Whenever the following occurs:
 - a. When there is a change in the initial arrangement, number, or type of local components in the analytical x-ray system.
 - b. Following maintenance requiring the disassembly or removal of a local component.
 - c. During the performance of maintenance and alignment procedures if the procedures require the presence of a primary x-ray beam when a local component in the system is disassembled or removed.
 - d. When a visual inspection of the local component in the system reveals an abnormal condition.
 - e. When the machine is operated in a manner other than the routine manner specified in the written operating procedures.
 - f. Whenever personnel monitoring devices show a significant increase over the previous monitoring period or the readings are approaching limits specified above.

VII. SAFETY DEVICES AND SIGNS

1. On equipment with an open beam configuration manufactured and installed after January 1, 1977, each port on the radiation source housing must be equipped with a shutter that cannot be opened unless a collimator or coupling has been connected to the port. (c) **Note:** *An open beam configuration system is an analytical x-ray system in which the beam is not enclosed or shielded so any portion of an individual's body, including fingers, could accidentally be placed in the beam path during normal operation.*
2. Unused ports on radiation housings shall be secured in the closed position in a manner which will prevent casual opening.
3. An open-beam configuration unit must have a device which either prevents the entry of any portion of body into primary beam path or causes the beam to be terminated when a part of the body approaches the beam. When the equipment is not so equipped, prior to operation the RSO may apply to the ADPH for an exemption from this requirement.
4. A warning label must be posted on the x-ray source housing which states, "Caution - High Intensity X-ray Beam", and another label which states, "Caution Radiation - This Equipment Produces Radiation When Energized", near any switch that energizes the X-ray tube.
5. An easily visible warning light which does the following:
 - a. Illuminates when the X-ray tube is energized and labeled with the words "X-Ray ON."
 - b. Illuminates in each port on radiation source housing when the shutter is open (this applies to open beam configurations). Unused ports must be secured in the closed position in a way that prevents casual opening.
 - c. In unattended operations each entrance to the room must have a warning light and the words "X RAY ON". For open beam unattended operations, there must be a device to shut off analytical x-ray equipment upon entrance of any person not trained.

VIII. OPERATING REQUIREMENTS

Operating procedures must be written and available to the analytical x-ray equipment operators. Procedures must include instructions for the following:

1. Sample insertion and manipulation
2. Equipment alignment
3. Routine maintenance and data recording procedures

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 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. Interlocks may not be used for routine shutdown in preparation for repairs (i.e. use the main shutdown switch).

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. In order to receive written approval, the following will be needed:

1. Whole-body and extremity dosimeters. To request dosimeters, use the same EHRS webpage listed above.
2. Calibrated survey meter that measures milliroentgen per hour (mR/hr).
3. Controls and procedures to assure the safety of individuals during the override.
4. A readily discernible sign bearing the words, "**SAFETY DEVICE NOT WORKING**" to be placed on the source housing.

X. PERSONNEL EXPOSURE MONITORING

Exposure to scattered radiation from analytical x-ray equipment is extremely low. The radiation levels are measured by the RSO, and must not exceed 0.25 mrem/hr at 5 centimeters from the surface of the protective cabinet for it to be routinely operable. Therefore personnel dosimetry is not required during routine use. However, personnel dosimetry is required for persons performing maintenance on x-ray diffraction units when a local component in the system is disassembled or removed, or when safety devices are disabled. Contact OEHS for dosimeters.

XI. EMERGENCY PROCEDURES

If anyone thinks they may have been exposed to the x-ray beam, please contact the OEHS immediately. OEHS is required to report suspected overexposures to the ADPH within 5 days of the incident, so **immediate action is required** by anyone suspecting that they have been exposed to the x-ray beam.

XII. IMPORTANT PHONE NUMBERS

The University of Alabama in Huntsville, Office of Environmental Health and Safety:
Monday – Friday during business hours **(256) 824-6053**
Radiation Safety Officer **(256) 824-3544**

UAH Police Department Emergency Numbers:

- **8911** from any campus phone
- **256-824-8911** from cell phones.
- **256-824-6596** for after hour **Non Emergencies**