XRD Safety Overview

v20200303

Overview

The Rigaku MiniFlex XRD is housed in the Department of Chemistry and Physics, Natural Science Building Room 226.

The instrument is meant to be used to support classroom/laboratory activities and for research purposes. All individuals, whether faculty or student, should obtain X-ray safety training from Al Fischer, Instrumentation Specialist, prior to use. All users are required to document that they have received proper training! Likewise, all users are required to sign in using the log sheet in this binder.

Access to the XRD must be restricted according to state law. This is done with password protection on the computer. Users should not share the password with anyone and should log out when they've completed their run. Additionally, individuals who have not had training should never enter the X-ray safety zone marked on the floor in NSB 226.

The XRD is fully shielded and does not require any personnel monitoring. Since the instrument is fully shielded, radiation surveys will be completed per NC Regulations for Protection Against Radiation, Section 0.804. They will be performed:

- Within 30 days of initial operation
- Prior to use following any change in the initial arrangement, including the number or type of local components in the system; and
- Prior to use following any maintenance requiring the disassembly or removal of a local component in the system that could affect the radiation exposure of personnel.

Testing of interlocks, shutters, and warming lights will be tested annually and documented.

A Ludlum 14C Survey Meter and detector are available for the surveys.

The North Carolina Radiation Protection guidelines are available via a shortcut on the XRD computer desktop.

Additional information and historic usage logs can be found in the archive binder obtained from Geosciences and Natural Resource during January 2020 when the XRD was transferred to Chemistry.

Personnel Requirements

No one will be permitted to operate or maintain analytical X-ray equipment unless the person has received instruction in:

- Identification of possible radiation hazards and the biological effects associated with equipment use.
- Significance of the various radiation and safety devices incorporated into the equipment.
- Proper training in equipment operation.
- Proper procedures for reporting actual or suspected exposure.

Hazards of X-ray Radiation

- X-rays are energetic radiation that can ionize matter.
- Ionizing radiation deposits energy, thereby causing chemical changes in cellular matter and thus biological changes.
- The changes to living cells include cell transformations, non-repairable cellular damage, cell death, and damage to genetic material.

- The extent and type of injury depends on the energy (wavelength) of the radiation and the intensity (amount) of radiation.
- The extent and type of injury also depends on the distance from the source. (Inverse square law -- intensity decreases with the square of distance.)
- Intensity from a scattered beam is much less than that from a direct beam.
- X-rays are invisible and impossible to see! The strongest intensity is in the path of the direct beam.

MiniFlex Safety Features

- The apparatus is equipped with a circuit breaker that will turn off in the event of a ground fault.
- The instrument is entirely contained within a metal enclosure, except for the computer. Opening the enclosure will trigger the interlocks and turn the instrument off.
- The **Ready** lamp on the front panel must be illuminated for X-ray generation. It will go out with the X-rays are turned on.
- The front panel and top of the instrument both contain X-ray indicator lights that glow when the X-ray source is on.
- The X-ray tube runs at fixed settings of 10 kV and 15 mA.
    - If the voltage exceeds 31.5 kB, the HVL light actuates to turn off the X-ray system.
    - If the voltage drops below 27.4 kV, the LVL actuates to turn off the X-ray system.
    - If the current rises above 15.75 mA, the HTC actuates to turn off the machine.
    - If the current drops below 13.7 mA, the LTC actuates to turn off the X-ray system.
- The X-rays must be turned off to open the sliding door on the front of the instrument.
- Opening the door or main enclosure triggers the safety interlocks and prevents ignition of the X-ray source.
- Do not tamper with the interlocks or other safety devices!
- In the event of an emergency, the large, round, red pushbutton on the front of the instrument will turn it off immediately.
- Changing of the X-ray tube should only be done under the direct supervision of a person trained in the procedure.
    - Handle the tube carefully
    - Run water for 30 minutes to cool it down and prevent burns.
    - The tube windows are made of beryllium. Beryllium is ***toxic***! If you touch it with your hands wash immediate with warm soapy water. Beryllium is also fragile -- do not touch it!
- The X-ray tube requires constant cooling when on and for 30 minutes after it has been shut off. Use the water chiller for this purpose.
- A CW error will display if water flow is insufficient to cool the X-ray source.
- Do not move, open, modify, or otherwise tamper with the equipment unless accompanied by trained personnel. (Moving the equipment requires a change to the Notice of Registration!)

Emergency Procedures

If you believe radiation is leaking from the cabinet or you hear otherwise unexplained warning signals, you may ***press the red, round pushbutton*** on the front of the instrument to immediately cut power and shut off the X-rays.

If you execute an emergency stop, immediately notify one of the emergency contact below and explain the reason for the stop (start at the top of the list and work your way down until you contact someone).

Emergency Contacts

Contact	Role	Office	Email	Phone
Al Fischer	**Instrumentation Specialist, XRD Authorized User**	**NSB 209**	**dfischer@wcu.edu**	**828-227-2695**
Wes Bintz	Research Operations Manager, Arts & Sciences	NSB 204	wwbintz@wcu.edu	828-227-2270
David Evanoff	Department Head, CHPH	NSB 231A	devanoff@wcu.edu	828-227-3667
Jon Maddy	Director, Safety and Risk Management	-	jmaddy@wcu.edu	828-227-7442
Sharon Tiqhe	Lab Safety Officer, Safety and Risk Management	-	smtighe@wcu.edu	828-227-7443
Campus Police	**Non-emergency**/after hours contact	-	-	828-227-730
Campus Dispatch	Fire/Medical/Police Emergency Response	-	-	828-227-8911
NC Radiation Protection Section	State Emergency Center	-	-	800-858-0368