

**Analytical X-Ray Machines
Self-Audit Checklist**

Building _____ Room _____ Principal Investigator _____ Date _____

Audit Performed by _____

Y	N	NA	COMMENTS
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I. Analytical X-Ray Machines that cannot exceed potentials above 16 kV:

A. Only the following requirements apply:

1. EHS radiation survey performed for machine in its current configuration and location.				
2. NJ State and Princeton University registration numbers posted on the machine.				
3. Radiation levels do not exceed 0.1 mR/hr at 5 cm from any accessible surface of the machine.				

II. All Analytical X-Ray machines capable of operating at potentials above 16 kV

A. General Requirements

1. EHS radiation survey performed for machine in its current configuration and location.				
2. Written operating and alignment procedures available.				
3. Safety systems checked every six months and results documented.				
4. Analytical x-ray equipment operated only when safety devices are functioning.				

Key to Analytical X-Ray Self-Audit Checklist

The possession and use of analytical x-ray machines is regulated by the New Jersey Department of Environmental Protection. The specific regulations pertaining to requirements for analytical x-ray machines are contained in N.J.A.C. 7:28-21.

4. Self-explanatory.

I. Analytical X-Ray Machines that cannot exceed potentials above 16 kV:

A. Only the following requirements apply:

1. EHS must be contacted to perform a radiation survey whenever a new machine is placed into service or whenever changes are made that could adversely affect radiation protection, including changes in machine location, shielding, experimental configuration, x-ray tube target, machine high voltage and current, etc.
2. Each analytical x-ray machine must be registered with NJDEP. EHS contacts the NJDEP and submits the registration form to initiate the registration process. As part of the registration process, NJDEP assigns a unique registration number to the machine. EHS posts a label with both the Princeton University and NJDEP registration numbers near any switch that energizes an x-ray machine.
3. Self-explanatory

II. All Analytical X-Ray machines capable of operating at potentials above 16 kV

A. General Requirements

1. EHS must be contacted to perform a radiation survey whenever a new machine is placed into service or whenever changes are made that could adversely affect radiation protection, including changes in machine location, shielding, experimental configuration, x-ray tube target, machine high voltage and current, etc.
2. Self-explanatory.
3. All components of the safety systems, including fail-safe lights and interlocks, must be tested at least every six months. Results of the safety tests must be documented in a log. If the machine is out of service for a period exceeding six months, a notation must be made in the safety system test log, and the safety systems must be tested when the machine has been repaired.

	Y	N	NA	COMMENTS
B. Postings, Signs and Warning Lights				
1. A clearly visible label with the words “Caution: This Equipment Produces X-Rays When Energized. To Be Operated Only By Authorized Personnel” attached near any switch that energizes the x-ray tube.				
2. A clearly visible label with the words “Caution: High Intensity X-Ray Beam” located in a conspicuous location near the x-ray tube housing.				
3. A clearly visible warning light with fail-safe characteristics, labeled with the words “X-Ray On”, located near any switch that energizes the x-ray tube.				
4. A clearly visible warning light with fail-safe characteristics, located near the tube housing, indicating when the x-ray tube is producing x-rays.				
5. NJ Notice to Employees, (RH-D14), posted.				
6. NJ State and Princeton University registration numbers posted on machine.				
7. “Caution: X-Ray” signs posted on doors entering the controlled area.				
C. Additional Requirements for Open Beam Systems				
1. A clearly visible warning light or indicator located near each x-ray tube shutter, indicating when the shutter is open.				
2. Suitable barrier or markings to delineate the boundary between the radiation area and the controlled area.				

Key to Analytical X-Ray Self-Audit Checklist

B. Postings, Signs and Warning Lights

1. Self-explanatory
2. Self-explanatory
3. Self-explanatory
4. Self-explanatory
5. "Notice to Employees," NJDEP Form #RH-D14, is posted in the laboratory or department. Copies are available from EHS.
6. Each analytical x-ray machine must be registered with NJDEP. EHS contacts the NJDEP and submits the registration form to initiate the registration process. As part of the registration process, NJDEP assigns a unique registration number to the machine. EHS posts a label with both the Princeton University and NJDEP registration numbers near any switch that energizes an x-ray machine.
7. "Caution: X-Ray" signs are available from EHS.

C. Additional Requirements for an Open Beam System

1. Self-explanatory
2. A barrier or other markings must be set up to show the boundary between a radiation area (any area in which a major portion of a worker's body could receive a dose in excess of 5 mrem in 1 hour or 100 mrem in any workweek) and the surrounding area.
3. Self-explanatory

	Y	N	NA	COMMENTS
3. A system barrier surrounding each radiation area and limiting the dose to individuals in the surrounding controlled area to less than 5 mrem in 1 hour or 100 mrem in 5 consecutive days.				
4. Beam shutter provided for each port of the x-ray tube housing.				
5. Guard or interlock capable of preventing entry of any part of the body into the primary beam.				
6. Each shutter interlocked to allow shutter opening only when the collimator or apparatus coupling is in place.				
7. Shutters on unused ports secured.				
D. Additional Requirements for Enclosed Beam Systems				
1. Interlocks to prevent x-ray exposure while enclosure is open.				
2. Chambers enclosing the x-ray tube housing, sample, detector and analyzing crystal to prevent entry of any part of the body during normal operation.				
3. Fail-safe interlock on sample chamber closure.				
E. Monitoring and Training Requirements				
1. Finger and body radiation monitoring badges provided for each user.				
2. Personnel monitoring results made available to machine users.				
3. All users trained by the Health Physics Staff				

Key to Analytical X-Ray Self-Audit Checklist

4. Self-explanatory
5. Self-explanatory
6. Self-explanatory
7. Self-explanatory

D. Additional Requirements for Enclosed Beam Systems

1. Safety interlocks must be provided so that the opening of any section of the enclosure during normal operation or routine alignment will either shut down the high voltage to prevent the generation of x-rays or will close the shutter to prevent the emergence of the primary beam.
2. Self-explanatory

3. Self-explanatory

E. Monitoring and Training Requirements

1. All persons who use an analytical x-ray machine capable of operating at potentials in excess of 16 kV are assigned and must wear finger and body personnel monitoring badges.
2. Users must have access to their dosimetry records which are available from the person responsible for the machine or from EHS.
3. All users must receive training by the Health Physics staff before working with analytical x-ray equipment.