TITLE 180 CONTROL OF RADIATION

CHAPTER 8 RADIATION SAFETY REQUIREMENTS FOR ANALYTICAL X-RAY EQUIPMENT

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8-001 SCOPE AND AUTHORITY

8-001.01 180 NAC 8 provides special requirements for analytical x-ray equipment. The regulations are authorized by and implement the Radiation Control Act, Neb. Stat. Rev. §§ 71-3501 to 71-3520. For purposes of this section, analytical x-ray equipment include, but are not limited to, handheld x-ray fluorescence, x-ray spectrography, and x-ray diffraction.

8-001.02 The requirements of this 180 NAC 8 are in addition to, and not in substitution for applicable requirements in 180 NAC 1, 2, 4, 10, 15, 17 and 18.

8-002 DEFINITIONS: As used in 180 NAC 8, the following definitions apply:

Analytical x-ray equipment means equipment used for x-ray diffraction or fluorescence analysis.

Analytical x-ray system means a group of components utilizing x or gamma rays to determine the elemental composition or to examine the microstructure of materials.

Fail-safe characteristics means a design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon the failure of safety or warning device.

Local components means part of an analytical x-ray system and include areas that are struck by x-rays such as radiation source housing, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors and shielding, but do not include power supplies, transformers, amplifiers, readout devices, and control panels.

Normal operating procedures mean step-by-step instructions necessary to accomplish the analysis. These procedures must include sample insertion and manipulation, equipment alignment, routine maintenance by the registrant or licensee, and data recording procedures which are related to radiation safety.

Open-beam configuration means an analytical x-ray system in which an individual could accidentally place some part of his body in the primary beam path during normal operation.

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Primary beam means radiation which passes through an aperture of the source housing by a direct path from the x-ray tube or a radioactive source located in the radiation source housing.

Safety device means a device that prevents the entry of any portion of an individual's body into the primary x-ray beam path or that causes the beam to be shut off upon entry into its path.

8-003 EQUIPMENT REQUIREMENTS:

8-003.01 Safety Device.

8-003.01A A safety device which prevents the entry of any portion of an individual's body into the primary x-ray beam path or which causes the beam to be shut off upon entry into its path must be provided on all open-beam configurations.

8-003.01B A registrant or licensee may apply to the Department for an exemption from the requirement of a safety device. Such exemption must be granted provided that the Department makes a finding that the exemption will not constitute a significant risk to the health and safety of the public. Such application must include:

1. A description of the various safety devices that have been evaluated;
2. The reason each of these devices cannot be used; and
3. A description of the alternative methods that will be employed to minimize the possibility of an accidental exposure, including procedures to assure that operators and others in the area will be informed of the absence of safety devices.

8-003.02 Warning Devices

8-003.02A Open-beam configurations must be provided with a readily discernible indication of:

1. X-ray tube status (ON-OFF) located near the radiation source housing, if the primary beam is controlled in this manner; and/or

2. Shutter status (OPEN-CLOSED) located near each port on the radiation source housing, if the primary beam is controlled in this manner.

8-003.02B Warning devices must be labeled so that their purpose is easily identified. On equipment installed after June 27, 1983, warning devices must have fail-safe characteristics.

8-003.03 Ports: Unused ports on radiation source housings must be secured in the closed position in a manner which will prevent inadvertent opening.

8-003.04 Labeling: All analytical x-ray equipment must be labeled with a readily discernible sign or signs bearing the radiation symbol and the words:

1. "CAUTION - HIGH INTENSITY X-RAY BEAM," or words having a similar intent, on the x-ray source housing; and
2. "CAUTION RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED," or words having a similar intent, near any switch that energizes an x-ray tube if the radiation source is an x-ray tube; or
3. "CAUTION - RADIOACTIVE MATERIAL," or words having a similar intent, on the source housing in accordance with 180 NAC 4-033 if the radiation source is a radionuclide.

8-003.05 Shutters: On open-beam configurations installed after June 27, 1983, each port on the radiation source housing must be equipped with a shutter that cannot be opened unless a collimator or a coupling has been connected to the port.

8-003.06 Warning Lights

8-003.06A An easily visible warning light labeled with the words "X-RAY ON," or words having a similar intent, must be located:

1. Near any switch that energizes an x-ray tube and must be illuminated only when the tube is energized; or
2. In the case of a radioactive source, near any switch that opens a housing shutter, and must be illuminated only when the shutter is open.

8-003.06B On equipment installed after June 27, 1983, warning lights must have fail-safe characteristics.

8-003.07 Radiation Source Housing: Each radiation source housing must be subject to the following requirements:

1. Each x-ray tube housing must be equipped with an interlock that shuts off the tube if it is removed from the radiation source housing or if the housing is disassembled.

2. Each radioactive source housing or port cover or each x-ray tube housing must be so constructed that, with all shutters closed, the radiation measured at a distance of 5 cm from its surface is not capable of producing a dose in excess of 0.025 mSv (2.5 mrem) in one hour. For systems utilizing x-ray tubes, this limit must be met at any specified tube rating.

8-003.08 Generator Cabinet. Each x-ray generator must be supplied with a protective cabinet which limits leakage radiation measured at a distance of 5 cm from its surface such that it is not capable of producing a dose in excess of 2.5 uSv (0.25 mrem) in one hour.

8-004 AREA REQUIREMENTS

8-004.01 Radiation Levels: The local components of an analytical x-ray system must be located and arranged and must include sufficient shielding or access control such that no radiation levels exist in any area surrounding the local component group which could result in a dose to an individual present therein in excess of the dose limits given in 180 NAC 4-013. For systems utilizing x-ray tubes, these levels must be met at any specified tube rating.

8-004.02 Surveys

8-004.02A Radiation surveys, as required by 180 NAC 4-021, of all analytical x-ray systems sufficient to show compliance with 180 NAC 8-004.01 must be performed:

1. Upon installation of the equipment and at least once every 12 months thereafter;
2. Following any change in the initial arrangement, number, or type of local components in the system;
3. Following any maintenance requiring the disassembly or removal of a local component in the system;
4. During the performance of maintenance and alignment procedures if the procedures require the presence of a primary x-ray beam when any local component in the system is disassembled or removed;
5. Any time a visual inspection of the local components in the system reveals an abnormal condition; and
6. Whenever personnel monitoring devices show a significant increase over the previous monitoring period or the readings are approaching the limits specified in 180 NAC 4-005.

8-004.02B Radiation survey measurements will not be required if a registrant or licensee can demonstrate compliance to the satisfaction of the Department with 180 NAC 8-004.01 in some other manner.

8-004.03 Posting: Each area or room containing analytical x-ray equipment must be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION X-RAY EQUIPMENT" or words having a similar intent in accordance with 180 NAC 4-033.

8-005 OPERATING REQUIREMENTS

8-005.01 Procedures: Normal operating procedures must be written and available to all analytical x-ray equipment workers. No individual will be permitted to operate analytical x-ray equipment in any manner other than that specified in the procedures unless the individual has obtained written approval of the radiation safety officer.

8-005.02 Bypassing: No individual must bypass a safety device or interlock unless the individual has obtained the approval of the radiation safety officer. Such approval must

be for a specified period of time. When a safety device or interlock has been bypassed, a readily discernible sign bearing the words "SAFETY DEVICE NOT WORKING", or words having a similar intent, must be placed on the radiation source housing.

8-005.03 Repair or Modification of X-Ray Tube Systems: Except as specified in 180 NAC 8-005.02, no operation involving removal of covers, shielding materials or tube housing or modifications to shutters, collimators, or beam stops must be performed without ascertaining that the tube is off and will remain off until safe conditions have been restored. The main switch, rather than interlocks, must be used for routine shutdown in preparation for repairs.

8-005.04 Radioactive Source Replacement, Testing, or Repair: Radioactive source housing must be opened for source replacement, leak testing, or other maintenance or repair procedures only by individuals authorized to specifically conduct the procedures under a license issued by the U.S. Nuclear Regulatory Commission or an Agreement State.

8-006 PERSONNEL REQUIREMENTS

8-006.01 Instruction: No individual is permitted to operate or maintain analytical x-ray equipment unless the individual has received four hours of instruction in and demonstrated competence as to:

1. Identification of radiation hazards associated with the use of the equipment;
2. Significance of the various radiation warning and safety devices, and interlocks incorporated into the equipment, or the reasons they have not been installed on certain pieces of equipment and the extra precautions required in such cases;
3. Proper operating procedures for the equipment;
4. Recognition of symptoms of an acute localized exposure;
5. Proper procedures for reporting an actual or suspected exposure; and
6. Radiation protection commensurate with the hazards of the device.

8-006.02 Personnel Monitoring

1. Finger or wrist dosimetric devices must be provided to and must be used by:

    a. Analytical x-ray equipment workers using systems having an open-beam configuration and not equipped with a safety device; and
    b. Personnel maintaining analytical x-ray equipment if the maintenance procedures require the presence of a primary x-ray beam when any local component in the analytical x-ray system is disassembled or removed.

2. Reported dose values must not be used for the purpose of determining compliance with 180 NAC 4-005 unless evaluated by a qualified expert as specified in 180 NAC 15-013.03.