

**Chapter 246-228 WAC**  
**RADIATION PROTECTION—ANALYTICAL X-RAY EQUIPMENT**

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**WAC**

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**WAC 246-228-001 Purpose and scope.** This chapter provides special requirements for analytical X-ray equipment. The requirements of this chapter are in addition to, and not in substitution for, applicable requirements in other chapters of these regulations.

[Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), reclassified as § 246-228-001, filed 12/27/90, effective 1/31/91; Order 1084, § 402-40-010, filed 1/14/76.]

**WAC 246-228-010 Definitions.** (1) "Analytical X-ray equipment" means equipment used for X-ray diffraction or fluorescence analysis.

(2) "Analytical X-ray system" means a group of components utilizing X-rays to determine the elemental composition or to examine the microstructure of materials.

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

(4) "Local components" mean parts of an analytical X-ray system and include areas that are struck by X-rays such as radiation source housings, ports and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors, and shielding, but do not include power supplies, transformers, amplifiers, readout devices, and control panels.

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

(6) "Open-beam configuration" means a mode of operation of an analytical X-ray system in which an individual could accidentally place some part of their body into the primary beam during normal operation if no further safety devices are incorporated.

(7) "Primary beam" means ionizing radiation which passes through an aperture of the source housing via a direct path from the X-ray tube located in the radiation source housing.

[Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), reclassified as § 246-228-010, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.98.050. WSR 81-01-011 (Order 1570), § 402-40-020, filed 12/8/80; Order 1084, § 402-40-020, filed 1/14/76.]

**WAC 246-228-020 Equipment requirements.** (1) *Safety device.* A 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, shall be provided for all open-beam configurations. A registrant or licensee may apply to the department for an exemption from the requirement of a safety device. Such application shall include:

(a) A description of the various safety devices that have been evaluated;

(b) The reason each of these devices cannot be used; and

(c) 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.

(2) *Warning devices.* Open-beam configurations shall be provided with a readily discernible indication of:

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

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

(c) Warning devices shall be labeled so that their purpose is easily identified and the devices shall be conspicuous at the beam port. On new equipment installed after January 1, 1976, warning devices shall have fail-safe characteristics.

(3) *Ports.* Unused ports on radiation source housings shall be secured in the closed position in a manner which will prevent casual opening. Such security requirement will be deemed met if the beam port cannot be opened without the use of tools not part of the closure for units installed after January 1, 1981.

(4) *Labeling.* All analytical X-ray equipment shall be labeled with a readily discernible sign or signs bearing the radiation symbol and the words:

(a) "CAUTION - HIGH INTENSITY X-RAY BEAM," or words having a similar intent, on the X-ray source housing; and

(b) "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

(c) "CAUTION - RADIOACTIVE MATERIAL," or words having a similar intent, on the source housing if the radiation source is a radionuclide.

(5) *Shutters.* On new equipment employing open-beam configurations installed after January 1, 1981, each port on the radiation source housing shall be equipped with a shutter that cannot be opened unless a collimator or a coupling has been connected to the port.

(6) *Warning lights.* An easily visible warning light labeled with the words "X-RAY ON," or words having a similar intent, shall be located:

(a) Near any switch that energizes an X-ray tube and near any X-ray port and shall be illuminated only when the tube is energized; or

(b) In the case of a radioactive source, near any switch that opens a housing shutter, and shall be illuminated only when the shutter is open.

(c) On equipment installed after January 1, 1981, warning lights shall have fail-safe characteristics.

(7) *Radiation source housing.* Each X-ray tube housing shall be so constructed that with all shutters closed the leakage radiation measured at a distance of 5 cm from its surface is not capable of producing a dose equivalent in excess of 2.5 mrem in one hour at any speci-

fied tube rating. If radioactive sources are used, corresponding dose limits shall not exceed 2.5 mrem per hour.

(8) *Generator cabinet.* Each X-ray generator shall 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 equivalent in excess of 0.25 mrem in one hour.

[Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), recodified as § 246-228-020, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.98.050. WSR 81-01-011 (Order 1570), § 402-40-030, filed 12/8/80; Order 1084, § 402-40-030, filed 1/14/76.]

**WAC 246-228-030 Facility requirements.** (1) *Radiation levels.*

The local components of an analytical X-ray system shall be located and arranged and shall 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 equivalent limits given in WAC 246-221-060 of these regulations. For systems utilizing X-ray tubes, these levels shall be met at any specified tube rating.

(2) *Surveys.* Radiation surveys, as required by WAC 246-221-110 of all analytical X-ray systems, sufficient to show compliance with WAC 246-228-030(1), shall be performed:

(a) Upon installation of the equipment, and at least once every twelve months thereafter;

(b) Following any change in the initial arrangement, number, or type of local components in the system;

(c) Following any maintenance requiring the disassembly or removal of a local component in the system;

(d) 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;

(e) Any time a visual inspection of the local components in the system reveals an abnormal condition; and

(f) Whenever personnel monitoring devices required in WAC 246-228-050(2) show a significant increase over the previous monitoring period or the readings are approaching 1/10 of the hands and forearm limit specified in WAC 246-221-010.

(g) Radiation survey measurements shall not be required if a registrant or licensee can demonstrate compliance to the satisfaction of the department with WAC 246-228-030(1) in some other manner.

(3) *Posting.* Each area or room containing analytical X-ray equipment shall 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.

(4) *Documentation of instruction.* Each facility shall maintain written documentation showing that compliance with WAC 246-228-050 has been met, and shall make such documentation available to the department upon request.

[Statutory Authority: RCW 70.98.050 and 70.98.080. WSR 91-15-083 (Order 183), § 246-228-030, filed 7/23/91, effective 8/23/91. Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), recodified as § 246-228-030, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.98.050. WSR 81-01-011 (Order 1570), § 402-40-040, filed 12/8/80; Order 1084, § 402-40-040, filed 1/14/76.]

**WAC 246-228-040 Operating requirements.** (1) *Procedures.* Routine operating procedures shall be written and available to all analytical X-ray equipment workers. No person shall be permitted to operate analytical X-ray equipment in any manner other than that specified in the procedures unless such person has obtained written approval of the radiation safety officer.

(2) *Bypassing.* No person shall bypass a safety device unless such person has obtained the written approval of the radiation safety officer. Such approval shall be for a specified period of time. When a safety device has been bypassed, a readily discernible sign bearing the words "SAFETY DEVICE NOT WORKING," or words having a similar intent, shall be placed on the radiation source housing. The requirements set forth in WAC 246-228-020(1) shall also be met.

[Statutory Authority: RCW 70.98.050 and 70.98.080. WSR 91-15-083 (Order 183), § 246-228-040, filed 7/23/91, effective 8/23/91. Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), recodified as § 246-228-040, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.98.050. WSR 81-01-011 (Order 1570), § 402-40-050, filed 12/8/80; Order 1084, § 402-40-050, filed 1/14/76.]

**WAC 246-228-050 Personnel requirements.** (1) *Instruction.* No person shall be permitted to operate or maintain analytical X-ray equipment unless such person has received instruction in and demonstrated competence as to:

(a) Identification of radiation hazards associated with the use of the equipment;

(b) Significance of the various radiation warning and safety devices 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;

(c) Proper operating procedures for the equipment;

(d) Symptoms of an acute localized exposure; and

(e) Proper procedures for reporting an actual or suspected exposure.

(2) *Personnel monitoring.* Finger or wrist dosimetric devices shall be provided to and shall 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.

(c) Reported dose values shall not be used for the purpose of determining compliance with WAC 246-221-010 of these regulations unless evaluated by a qualified expert.

[Statutory Authority: RCW 70.98.050 and 70.98.080. WSR 91-15-083 (Order 183), § 246-228-050, filed 7/23/91, effective 8/23/91. Statutory Authority: RCW 43.70.040. WSR 91-02-049 (Order 121), recodified as § 246-228-050, filed 12/27/90, effective 1/31/91; Order 1084, § 402-40-060, filed 1/14/76.]