MICHIGAN DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
RADIATION SAFETY SECTION
IONIZING RADIATION RULES GOVERNING THE USE OF RADIATION MACHINES

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PART 13. MISCELLANEOUS SOURCES

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R 333.5481 Purpose and scope.

Rule 481. (1) This part establishes radiation safety requirements for miscellaneous radiation sources and for persons utilizing sources not exempted under R 333.5015 and not specifically covered elsewhere by these rules.

(2) This part applies to all persons who use sources of radiation not specifically covered by the other parts.

(3) In addition to the requirements of this part all persons and activities covered by this part are subject to the applicable provisions of R 333.5001 to R 333.5101.

History: 2016 MR 10, Eff. May 25, 2016

ANALYTICAL X-RAY SOURCES

R 333.5482 X-ray equipment.

Rule 482. (1) Tube housing leakage from analytical x-ray sources shall not exceed 0.5 milliroentgen per hour at a 5 centimeter distance from the surface of the tube housing with the beam ports blocked and the tube operating at its leakage technique factors. Also, radiation originating from the high voltage power supplies shall not exceed this limit.

(2) For instruments in which the primary x-ray beam is completely enclosed, the radiation shall be less than 2 milliroentgens per hour at a distance of 25 centimeters from the cabinet surface.

(3) For enclosed equipment, interlocks shall be provided on all access panels which terminate exposure and prevent operation while the panel is removed.

(4) Open beam analytical x-ray equipment shall meet all of the following:

- **(a)** X-ray diffraction cameras shall have the appropriate ports arranged so that the camera collimating system is in place before the x-ray tube can be energized or the shutter can be opened.
- **(b)** An adapter between the x-ray tube and the collimator of the diffractometer camera or other accessory shall provide protection equivalent to that required by subrule (1) of this rule.
- **(c)** Safety interlocks shall not be used as routine cut-off switches during normal operation. They shall be operated as safety devices only, and tested periodically. When the interlock system terminates the x-ray beam, it shall be necessary to reset the "on" switch at the control panel to resume operation.
- **(d)** Tube head ports which are not in use shall be secured in a closed position and interlocked to the x-ray generator or warning system.
- **(e)** The shutter indicator shall be conspicuously displayed to disclose the "open" or "closed" position of the shutter.
- **(f)** The instrument shall display a conspicuous warning label such as "CAUTION RADIATION - THIS EQUIPMENT PRODUCES X-RADIATION WHEN ENERGIZED."
- **(g)** A red warning light shall indicate "X-RAY ON" when the equipment is producing x-rays. Other signal lights or alarms shall operate only to indicate a malfunction which may produce a radiation, electrical, or other hazard.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5484 Administrative procedures.

Rule 484. A radiation protection supervisor shall be appointed to be responsible for radiation safety. This individual's primary job duty shall not be operating the x-ray equipment. The radiation protection supervisor or designated representative shall do all of the following:

- **(a)** Ensure that operational and maintenance procedures are followed.
- **(b)** Provide instruction in safety practices for all individuals working with the x-ray equipment, and those working in the immediate area or periodically review the safety instruction provided for these individuals.
- **(c)** Maintain a personnel monitoring system, as required by R 333.5487.
- **(d)** Review, approve, and supervise modifications or replacement of parts for the x-ray apparatus.
- **(e)** Conduct surveys and tests as necessary to certify compliance with these rules, including specific registration conditions, and maintain records thereof for examination by the department.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5485 Operators.

Rule 485. (1) An individual shall not act as the operator of analytical x-ray equipment until he or she has received training in radiation safety and has been approved by the radiation protection supervisor or designated representative. The operator shall also demonstrate competence in the use of the machine and radiation survey instruments.

(2) The operator shall be responsible for complying with all procedures associated with the x-ray equipment.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5486 Operating procedures.

Rule 486. A set of operating procedures, written in understandable and concise language, shall be posted on or adjacent to the machine.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5487 Personnel monitoring.

Rule 487. An operator of analytical x-ray equipment having an open-beam configuration shall be provided with finger or wrist radiation monitoring devices. An analytical x-ray system having an open-beam configuration is one in which an individual could accidentally place some part of his or her body in the primary beam path during normal operation. An individual coming in contact with equipment capable of exposing a major portion of the body shall be required to wear whole-body monitoring equipment at all times. Personnel coming in contact with this equipment shall be warned of the nature and type of physiological effects that may be expected when overexposed to radiation.

History: 2016 MR 10, Eff. May 25, 2016

COLD-CATHODE GAS DISCHARGE TUBES

R 333.5491 Rules applicable.

Rule 491. Cold-cathode gas discharge tubes designed to demonstrate the effects of a flow of electrons or the production of x-radiation are subject to the requirements of R 333.5492 to R 333.5495.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5492 Exposure rate limit.

Rule 492. (1) Radiation exposure rates produced by cold-cathode gas discharge tubes shall not exceed 10 mR/hr at a distance of 30 centimeters from a point on the external surface of the tube, as measured pursuant to R 333.5493.

(2) The divergence of the exit beam from tubes designed primarily to demonstrate the effects of x-radiation, with the beam blocking device in the open position, shall not exceed π (Pi) steradians.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5493 Measurements.

Rule 493. (1) Compliance with the exposure rate limit specified in R 333.5492 (1) shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension exceeding 20 centimeters.

(2) Measurements of exposure rates from tubes in enclosures from which the tubes cannot be removed without destroying the function of the tube may be made at a distance of 30 centimeters from a point on the external surface of the enclosure under either of the following conditions:

- **(a)** In the case of enclosures containing tubes designed primarily to demonstrate the production of x-radiation, measurements shall be made with a beam blocking device in the beam blocking position.
- **(b)** In the case of enclosures containing tubes designed primarily to demonstrate the effects of a flow of electrons, measurements shall be made with all movable or removable parts of the enclosure in the position which would maximize external exposure levels.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5494 Test conditions.

Rule 494. (1) Measurements shall be made under the conditions of use specified in instructions provided by the manufacturer.

(2) Measurements shall be made with the tube operated under forward and reverse polarity.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5495 Instructions; labels and warnings.

Rule 495. (1) For each tube to which R 333.5492 to R 333.5495 are applicable, the registrant shall ensure the availability of appropriate safety instructions and instructions for the use of the tube. These instructions shall include the specification of a power source for use with the tube.

(2) An enclosure or tube shall have tags or labels inscribed on or permanently affixed, which identify the intended polarity of the terminals and shall include either of the following:

- **(a)** In the case of tubes designed primarily to demonstrate the heat effect, fluorescence effect, or magnetic effect, a warning that application of power in excess of that specified may result in the production of x-rays in excess of allowable limits.
- **(b)** In the case of tubes designed primarily to demonstrate the production of x-radiation, a warning that this device produces x-rays when energized.

(3) The tag or label required by subrule (2) of this rule shall be located on the tube or enclosure so as to be readily visible and legible when the product is fully assembled for use.

History: 2016 MR 10, Eff. May 25, 2016

ELECTRON MICROSCOPES

R 333.5505 Equipment.

Rule 505. (1) During all phases of operation of an electron microscope at the maximum rated continuous tube current for the maximum rated peak tube potential the radiation exposure rate as measured in air at a distance of 5 centimeters from an accessible point on the external surface of the microscope shall not exceed 0.5 milliroentgen per hour.

(2) Interlocks shall be provided on all potential radiation hazard access panels which terminate exposure and prevent operation while the panel is removed.

(3) The instrument shall display a conspicuous warning label such as "CAUTION RADIATION - THIS EQUIPMENT PRODUCES X-RADIATION WHEN ENERGIZED."

(4) Electron microscopes that are not capable of exceeding an operating potential of 50 kilovolts are exempt from the requirements of R 333.5505 to R 333.5508.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5506 Administrative procedures.

Rule 506. A radiation protection supervisor shall be appointed to be responsible for radiation safety. This individual shall not normally operate the electron microscope. The radiation protection supervisor or a designated representative shall do all of the following:

- **(a)** Ensure that operational and maintenance procedures are followed.
- **(b)** Provide instruction in safety practices for all persons working with the electron microscope, and those working in the immediate area.
- **(c)** Maintain a personnel monitoring system, if provided.
- **(d)** Review, approve, and supervise modifications or replacement of parts for the electron microscope.
- **(e)** Conduct surveys and tests as necessary to certify compliance with these rules, including specific registration conditions.
- **(f)** Maintain records of surveys and tests for examination by the department.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5507 Operators.

Rule 507. (1) An individual shall not act as operator of an electron microscope unless he or she has demonstrated to the satisfaction of the radiation protection supervisor or designated representative both of the following:

- **(a)** Competence in the safe use of the instrument.
- **(b)** Awareness of the potential radiation hazard which could result from improper adjustment or misuse of the instrument.

(2) The operator shall be responsible for complying with all procedures associated with the instrument.

History: 2016 MR 10, Eff. May 25, 2016

R 333.5508 Operating procedures.

Rule 508. A set of operating procedures, written in understandable and concise language shall be posted on or adjacent to the electron microscope.

History: 2016 MR 10, Eff. May 25, 2016

OTHER MISCELLANEOUS SOURCES

R 333.5511 Registration conditions.

Rule 511. Types of radiation sources and uses not specifically covered by these rules shall be subject to specific requirements designated by the department in the form of registration conditions for the protection of public health, safety, and property until these rules are amended to specifically cover these sources and uses.

History: 2016 MR 10, Eff. May 25, 2016