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SUBCHAPTER 17. INDUSTRIAL AND NONMEDICAL RADIOGRAPHY
INDUSTRIAL AND NONMEDICAL RADIOGRAPHY

7:28-17.1 Scope

- (a) This subchapter establishes radiation-safety requirements for persons utilizing sealed sources, radiographic-exposure devices or ionizing radiation-producing machines for industrial and nonmedical radiography.
- (b) The requirements of this subchapter are in addition to the requirements of N.J.A.C. 7:28-1 through 7:28-13.
- (c) This Subchapter does not apply to radiography in any of the healing arts.

Amended by R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).
language change.

7:28-17.2 Definitions

The following words and terms, when used in this subchapter, shall have the following meanings, unless the context clearly indicates otherwise.

□Cabinet X-ray system□ means an ionizing radiation-producing machine with the x-ray tube installed in an enclosure which, independent of existing architectural structures except the floor on which it may be placed, is intended to contain at least that portion of a material being irradiated, provide radiation attenuation, and exclude personnel from its interior during generation of x-radiation, including but not limited to all x-ray systems designed primarily for the inspection of carry-on baggage at air, railroad, and bus terminals, and similar facilities, and all x-ray systems designed primarily for the inspection of letters, periodicals, and packages in mailrooms. An x-ray tube used within a shielded part of a building or x-ray equipment which may temporarily or occasionally incorporate portable shielding, is not considered a cabinet x-ray system.

□External surface□ means the outside surface of the cabinet x-ray system, including the high-voltage generator, doors, access panels, latches, control knobs, and other permanently mounted hardware and including the plane across any aperture or port.

□Industrial radiography□ means the examination of the macroscopic structure of materials by nondestructive methods using sources of radiation.

□Shielded room radiography□ means industrial radiography which is conducted in an enclosed room, the interior of which is not occupied during radiographic operations.

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□Temporary job site□ means any location where industrial radiography is performed other than the location(s) listed in a license or registration issued by the Department pursuant to N.J.A.C. 7:28-3 or 7:28-4.

New Rule R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

□Registration and licensing requirements□ recodified to 17.3.

7:28-17.3 Registration and licensing requirements

- (a) All owners of ionizing radiation-producing machines shall comply with N.J.A.C. 7:28-3.
- (b) All owners of sealed sources or radiographic-exposure devices shall comply with N.J.A.C. 7:28-3 and 7:28-4.

Amended by R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

Recodified from 17.2; □Equipment control□ recodified to 17.4.

7:28-17.4 Equipment control

- (a) The permissible levels of radiation from radiographic-exposure devices and storage containers shall be as follows:
 - 1. Radiographic-exposure devices measuring less than four inches from the sealed source storage position to any external surface of the device shall not produce a radiation level in excess of 50 milliroentgens per hour at least six inches from any point on the external surface of the device.
 - 2. Radiographic-exposure devices measuring a minimum of four inches from the sealed source storage position to any external surface of the device and all storage containers for sealed sources or for radiographic-exposure devices shall not produce radiation levels in excess of 200 milliroentgens per hour at any point on the external surface and 10 milliroentgens per hour at one meter from any point on the external surface.
 - 3. The radiation levels specified in 1 and 2 above are with the sealed source in the shielded or □off□ position.
- (b) Each radiation-producing machine shall be provided with a lock designed to prevent unauthorized use of the equipment.
- (c) Each radiographic-exposure device and each storage container shall be provided with a lock or outer locked container designed to prevent unauthorized or

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- accidental removal of a sealed source or its change from a shielded to an unshielded position. All ionizing radiation-producing machines, radiographic-exposure devices and storage containers shall be kept locked at all times except when under the direct surveillance of a radiographer or of a radiographer's assistant or as provided in N.J.A.C. 7:28-17.6(a).
- (d) Locked radiographic-exposure devices and storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.
- (e) The owner shall maintain sufficient calibrated and operable radiation-survey instruments to make physical radiation surveys as required by N.J.A.C. 7:28-17.6(c) and by N.J.A.C. 7:28-7. The requirements for the radiation-survey instruments are as follows:
1. Each radiation-survey instrument shall be calibrated at intervals not to exceed three months and the instrument shall be recalibrated after each servicing involving other than battery replacement. An operational check source test shall be performed on each radiation-survey instrument prior to its use.
 2. Records shall be maintained of each date of calibration and the operational check source test results.
 3. The instrumentation shall have a range such that two milliroentgens per hour through one roentgen per hour can be measured to a precision of plus or minus 20 per cent.
- (f) The replacement of any sealed source fastened to or contained in a radiographic-exposure device and leak testing, repair, tagging, opening or any other modification of any sealed source shall be performed only by persons specifically authorized by the Department, a Federal agency or any Agreement state.
- (g) Sealed sources are to be leak tested under the following conditions and requirements:
1. Each sealed source shall be tested for leakage at intervals not to exceed six months. In the absence of a certificate from a transferor that a test has been made within the six months prior to the transfer, the sealed source shall not be put into use until tested.
 2. The leak test shall be capable of detecting the presence of 0.005 microcuries of removable contamination on the sealed source. A test made at the nearest accessible point to the sealed source storage position may be an acceptable leak test.

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3. Leak tests shall be carried out only by individuals and by procedures both of which require prior approval by the Department. Approval will be based upon a description of the following:
 - i. Instrumentation to be used;
 - ii. Method of performing test including points on equipment to be tested; and
 - iii. Pertinent experience of person who will perform the test.
 4. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Department.
- (h) Requirements regarding any leaking sealed source shall be as follows:
1. Any test conducted pursuant to (g) above which reveals the presence of 0.005 microcuries or more of removable radioactive material shall be considered evidence that a sealed source is leaking.
 2. The owner shall immediately withdraw any leaking sealed source above from use and shall cause it to be decontaminated and repaired in accordance with (f) or to be disposed of in accordance with N.J.A.C. 7:28-11.
 3. Within five working days after obtaining results of the test performed pursuant to (g) above, a report shall be filed with the Department describing the equipment involved, the test results, and the corrective action taken.
- (i) A sealed source which is not fastened to or contained in a radiographic-exposure device shall have permanently attached to it a durable tag at least one inch square, bearing the prescribed radiation caution symbol in conventional colors, magenta or purple on a yellow background, and at least the instructions: "Danger" "Radioactive Material" "Do Not Handle" "Notify Civil Authorities if Found."
- (j) Each owner shall conduct an ongoing inventory and keep a written record of each sealed source that is received, possessed, and used. This record shall include the date of receipt of each sealed source, the identity and quantity of the radioactive material contained within each sealed source, the date and to whom each sealed source is assigned and of the location at which each sealed source is to be used, the date that each sealed source is returned for storage at the owner's facility, the date that the source is returned for replacement, and the date of calibration.

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- (k) Each owner shall maintain current logs, which shall be kept available for inspection by the Department at the address specified in the license, showing for each radiation source the following information.
 - 1. A description, or make and model number of the ionizing radiation-producing machine, or of the radiographic-exposure device or storage container in which the sealed source is located;
 - 2. The identity of the radiographer to whom assigned; and
 - 3. The plant or site where used and dates of use.

- (l) Each owner conducting industrial radiography at a temporary job site shall make the following records available at that site for inspection by the Department:
 - 1. A copy of the owner's current license to possess or use radioactive materials issued by the Department pursuant to N.J.A.C. 7:28-4.
 - 2. A copy of the owner's current registration of a radioactive material or ionizing radiation-producing machine issued by the Department pursuant to N.J.A.C. 7:28-3;
 - 3. A copy of the owner's current license to possess or use radioactive materials issued by the United States Nuclear Regulatory Commission;
 - 4. A copy of the owner's operating and emergency procedures prepared pursuant to N.J.A.C. 7:28-17.5(d);
 - 5. A copy of N.J.A.C. 7:28;
 - 6. Survey records required pursuant to N.J.A.C. 7:28- 17.6(c) for the period of operation at the site;
 - 7. Daily pocket dosimeter records for the period of operation at the site required to be made pursuant to N.J.A.C. 7:28-17.5(e)2;
 - 8. A copy of the latest instrument calibration and the original log of daily instrument operational check source test results for the specific devices in use at the site required to be made pursuant to (e)1 and 2 above; and
 - 9. A copy of the record of leak test results made pursuant to (g)4 above.

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Amended by R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

Recodified from 17.3 with substantive changes.

7:28-17.5 Personal radiation safety requirements for radiographers

(a) The owner shall not permit any person to act as a radiographer until such person:

1. Has been instructed by a qualified individual in the subjects outlined in (b) below and has demonstrated an understanding of those subjects by passing a written examination given by a qualified individual;
2. Has received copies of and instruction in the applicable sections of this Chapter and the owner's operating and emergency procedures required pursuant to (d) below, and demonstrated an understanding of this Chapter and the procedures specified therein; and
3. Has demonstrated competence to use the ionizing radiation-producing machines, radiographic-exposure devices, sealed sources, related handling tools and survey instruments which will be employed in his assignment.

(b) The outline of the course for radiographer's training is as follows:

1. Fundamentals of radiation safety:
 - i. Characteristics of gamma and x-radiation;
 - ii. Units of radiation dose and quantity of radioactivity;
 - iii. Hazards of excessive exposure to radiation;
 - iv. Levels of radiation from ionizing radiation-producing machines and radioactive materials;
 - v. Methods of controlling radiation dose:
 - (1) Working time;
 - (2) Working distances;
 - (3) Shielding.
2. Radiation detection instrumentation to be used:
 - i. Use of ionizing radiation survey instruments:
 - (1) Operation;
 - (2) Calibration;
 - (3) Limitations.

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- ii. Survey techniques;
 - iii. Use of personnel-monitoring equipment:
 - (1) Film badges;
 - (2) Pocket dosimeters;
 - (3) Pocket chambers;
 - 3. Radiographic equipment to be used:
 - i. Ionizing radiation-producing machines;
 - ii. Radiographic-exposure devices;
 - iii. Storage containers;
 - iv. Remote handling equipment.
 - 4. The requirements of pertinent Federal and State regulations;
 - 5. The owner's written operating and emergency procedures.
- (c) The owner shall not permit any person to act as a radiographer's assistant until such person:
- 1. Has received copies of and instruction in the owner's operating and emergency procedures, required pursuant to (d) below, and has demonstrated an understanding of the procedures; and
 - 2. Has demonstrated competence to use under the personal supervision of the radiographer the ionizing radiation-producing machines, radiographic-exposure devices, sealed sources, related handling tools and radiation-survey instruments which will be employed in his assignment; and
 - 3. Has been instructed by a qualified individual in the subjects outlined in (b) above, and has demonstrated an understanding of those subjects by written examination given by a qualified individual.
- (d) The owner shall prepare written operating and emergency procedures which shall include instructions in at least the following:
- 1. The handling and the use of ionizing radiation-producing machines, sealed sources and radiographic-exposure devices to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in N.J.A.C. 7:28-6;
 - 2. Methods and occasions for conducting radiation surveys;

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3. Methods for controlling access to radiographic areas;
 4. Methods and occasions for locking and securing ionizing radiation-producing machines, radiographic-exposure devices, storage containers and sealed sources;
 5. Personnel monitoring and the use of personnel-monitoring equipment;
 6. Transporting sealed sources to field locations, including packing of radiographic-exposure devices and storage containers in the vehicles, posting of vehicles, and control of the sealed sources during transportation;
 7. Minimizing exposure of persons in the event of an accident;
 8. The procedure for notifying proper persons in the event of an accident; and
 9. Maintenance of records.
- (e) The owner shall not permit any person to act as a radiographer or as a radiographer's assistant unless the owner has supplied to each such person and requires that each such person shall wear a film badge and either a pocket dosimeter or pocket chamber. The requirement for use of film badges, pocket dosimeters, and pocket chambers are as follows:
1. Pocket dosimeters and pocket chambers shall be capable of measuring doses from zero to at least 200 milliroentgens.
 2. Pocket dosimeters and pocket chambers shall be read and doses recorded daily.
 3. A film badge will be assigned to and worn by only one person.
 4. A film badge shall be immediately processed if a pocket chamber or pocket dosimeter is discharged beyond its range.
 5. The film badge reports received from the film badge processor and records of pocket dosimeter and pocket chamber readings shall be maintained for inspection by the Department.

Amended by R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

Recodified from 17.4 with substantive changes.

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7:28-17.6 Precautionary procedures in radiographic operations

- (a) During each radiographic operation the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area, except as follows:
1. Where the high radiation area is equipped with a control device which shall either cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in one hour upon entry into the area, or shall energize a conspicuous visible and audible alarm signal in such a manner that the individual entering and the owner or the supervisor of the activity are made aware of the entry; or
 2. Where the high radiation area is locked to protect against unauthorized or accidental entry.
- (b) Notwithstanding any provisions in N.J.A.C. 7:28-10.8, areas in which radiography is being performed shall be conspicuously posted as required by N.J.A.C. 7:28-10.2 and 7:28-10.3.
- (c) No radiographic operation shall be conducted unless calibrated and operable ionizing radiation-survey instrumentation as described in N.J.A.C. 7:28-17.4(e) is available and used at each site where radiographic exposures are made. In addition to the requirements of N.J.A.C. 7:28-7, radiation surveys shall be made and recorded as follows:
1. Physical radiation surveys shall be made as necessary during radiographic exposures to determine compliance with N.J.A.C. 7:28-6.
 2. A physical radiation survey shall be made after each radiographic exposure employing a sealed source to determine that the sealed source has been returned to its shielded condition.
 3. After radiographic operations employing a sealed source or sources have been completed, a physical radiation survey shall be made to determine that each sealed source is in its shielded condition prior to securing the radiographic-exposure device and storage container as specified in N.J.A.C. 7:28-17.4(a) and (c).
 4. Clear and legible records shall be kept of the surveys that are required by (c) 1 and 3 above and maintained for inspection by the Department.

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Amended by R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

Recodified from 17.5 with substantive changes.

7:28-17.7 Cabinet x-rays systems

- (a) No person shall operate or permit the operation of a cabinet x-ray system unless such system meets the requirement of N.J.A.C. 7:28-17.1, 7:28-17.2, 7:28-17.3, and 7:28-17.7.
- (b) No person shall operate or permit any other person to operate a cabinet x-ray system until the operator has received a copy of the operator's manual, has been trained in the operating procedures for the system, and has demonstrated competence in operating the system. The owner shall maintain a copy of the operator's manual in the proximity of the system.
- (c) Each owner shall supply appropriate personnel monitoring equipment to and shall require that it be used by every individual who operates, makes "set-ups", or performs maintenance on a cabinet radiography unit.
- (d) Radiation emitted from the cabinet x-ray system shall not exceed an exposure of 0.5 milliroentgen in one hour at any point five centimeters outside the external surface.
- (e) No cabinet x-ray system shall be placed into operation until a radiation survey is made by a qualified individual demonstrating that the exposure level in (d) above is not exceeded. Where an operating system is subsequently modified, repaired or moved to a new location an additional survey shall be performed, and operation shall not resume until a survey demonstrates compliance with this limit. The owner shall perform such additional surveys as required by the Department or as determined by a qualified individual. The owner shall maintain a record of all surveys performed and shall make such records available to the Department for inspection.
- (f) Safety interlocks shall be provided on cabinet x-ray systems as follows:
 - 1. Each door of a cabinet x-ray system shall have a minimum of two safety interlocks installed in such a manner that the opening of any door would disconnect the energy supply circuit to the high-voltage generator.
 - 2. Each access panel on a cabinet x-ray system shall have at least one safety interlock.

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3. Following interruption of x-ray generation by the functioning of any safety interlock, a manually reset control button shall be activated before x-ray generation can resume.
4. Failure of any single component of the cabinet x-ray system shall not cause failure of more than one required safety interlock.
5. Safety interlocks shall be tested for operation at intervals not to exceed six months. A record of these tests shall be maintained for inspection by the Department.

(g) A cabinet x-ray system shall have a permanent floor.

Any support surface to which a cabinet x-ray system is permanently affixed may be deemed the floor of the system.

(h) Warning labels shall be provided on cabinet x-ray systems and shall meet the following requirements:

1. There shall be permanently affixed or inscribed on the cabinet x-ray system at the location of any controls which can be used to initiate x-ray generation a clearly legible and visible label bearing the statement or words having a similar meaning: "CAUTION: X-RAYS PRODUCED WHEN ENERGIZED"; and
2. There shall be permanently affixed or inscribed on the cabinet x-ray system adjacent to each port a clearly legible and visible label bearing the statement or words having a similar meaning: "CAUTION: DO NOT INSERT ANY PART OF THE BODY WHEN SYSTEM IS ENERGIZED: X-RAY HAZARD".

(i) All cabinet x-ray systems shall be provided with the following controls and indicators:

1. A key-actuated control to insure that x-ray generation is not possible with the key removed;
2. A control button or control switch to initiate and terminate the generation of x-rays other than by the functioning of a safety interlock or the main power control;
3. A warning light at the control button or control switch that indicates when and only when x-rays are being generated. This light shall be clearly labeled with the words: "X-RAY ON";

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4. A warning light which indicates when and only when x-rays are being generated. This warning light shall be visible from each door, access panel, and port and shall be clearly labeled with words: "X-RAY ON".
 5. A meter which indicates the kilovoltage and current during the generation of x-rays at each x-ray control button or control switch unless the x-ray tube current is preset.
- (j) Cabinet x-ray systems designed primarily for the inspection of carry-on baggage at airline, railroad, and bus terminals, and similar facilities, shall be provided with means to insure that an operator is present at the control area in a position which permits surveillance of the ports and doors during the generation of x-radiation as follows:
1. During an exposure or preset succession of exposures of one-half second or greater duration, the system shall contain a mechanism to enable the operator to terminate the exposure or preset succession of exposures at any time.
 2. During an exposure or preset succession of exposures of less than one-half second duration, there shall be a mechanism provided to allow completion of the exposure in progress but shall enable the operator to prevent additional exposures.

New Rule, R.1985 d.502, effective October 7, 1985.

See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).

7:28-17.8 Shielded room radiography

- (a) No person shall operate or permit the operation of any ionizing radiation-producing machine, radiographic-exposure device, or sealed source used in shielded room radiography unless the equipment, installation, and personnel meet the requirements of N.J.A.C. 7:28-17.1 through 7:28-17.6 and 7:28-17.8.
- (b) No person shall operate or permit any person to operate an ionizing radiation-producing machine, radiographic-exposure device, or sealed source used in shielded room radiography until such operator has completed the following requirements:
 1. The operator has met the requirements of N.J.A.C. 7:28-17.5;
 2. The operator has received a copy of and instruction in N.J.A.C. 7:28-1 through 7:28-13 and 7:28-17 and a copy of the owner's operating and emergency

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procedures as required by N.J.A.C. 7:28-17.5(d) and has demonstrated an understanding of the procedures and regulations by written examination given by a qualified individual; and

3. The operator has demonstrated competence to operate appropriate safety systems.
- (c) Each owner shall supply appropriate personnel monitoring equipment and shall require that it be used by every individual who operates, makes "set-ups," or performs maintenance on an ionizing radiation-producing machine, radiographic-exposure device, or sealed source used in shielded room radiography.
 - (d) The enclosed room in which shielded room radiography is conducted shall be shielded so that no location on the exterior exceeds the radiation levels and limits established in N.J.A.C. 7:28-6. No industrial radiography shall be conducted in a shielded room until a radiation survey is first made to insure compliance with these radiation levels and limits. A record of this survey shall be maintained and a copy shall be available for inspection by the Department.
 - (e) No person shall enter an enclosed room in which shielded room radiography is performed until after a physical radiation survey is conducted to determine whether the ionizing radiation producing machine is off or the radiographic-exposure device or the sealed source is in the shielded or "off" position. A record shall be maintained of the date and exposure rate measured for each physical radiation survey and shall be made available for inspection by the Department.
 - (f) The radiation surveys required in (d) and (e) above shall be made with a radiation survey instrument measuring radiation at the energies and at the exposure rates to be encountered. This instrument shall have an operational check source test conducted prior to each use and shall be calibrated at intervals not to exceed one year and shall be recalibrated after each servicing other than a battery replacement. Records shall be maintained of each date of calibration and the daily operational check and shall be made available for inspection by the Department.
 - (g) Adequate methods shall be provided to restrict the access of personnel and the public to any and all shielded room radiography areas to prevent the exposure of any person to radiation in excess of the level limits of N.J.A.C. 7:28-5, 7:28-6 and 7:28-17. No person is permitted to remain within the enclosed room where shielded room radiography is being performed.
 - (h) All ionizing radiation-producing machines, radiographic-exposure devices, and sealed sources used in shielded room radiography and all objects exposed thereto shall be confined within an installation or structure designed or intended for

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radiography and in which radiography is regularly performed in accordance with the following requirements:

1. A reliable interlock or other mechanism shall be installed at each means of access to the shielded room which will turn off the source(s) of radiation if a person tries to enter or open the door to the shielded room.
2. A door-fastening mechanism shall be installed so that the door to the shielded room can be opened from the inside at all times in case of emergency.
3. A visible and audible signal alarm system shall be installed within the shielded room which will be actuated at a reasonable length of time before the power to the radiation source can be activated which enables persons in the vicinity of the shielded room to take appropriate protective actions.
4. One or more scram or emergency buttons shall be installed at a highly visible and easily accessible location or locations within the shielded room that will terminate the power to the source of radiation. This scram or emergency button shall be installed so that it shall require manual resetting before the power to the source of radiation can be reactivated.
5. Each source of radiation used in shielded room radiography shall be provided with a lock at the control panel to prevent unauthorized use of the source.
6. If more than one source of radiation is used in the same shielded room, all such sources of radiation shall meet the requirements of 1-5 above.

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See: 17 N.J.R. 1626(a), 17 N.J.R. 2389(a).