CHAPTER 4730
DEPARTMENT OF HEALTH
IONIZING RADIATION

4730.0100 DEFINITIONS.

Subpart 1. **Appropriate limit.** "Appropriate limit" or "appropriate limits" means the maximum permissible dose or doses of radiation that may be administered to the whole body or a given part of a human being. See "maximum permissible concentrations," "maximum permissible doses," and "maximum permissible neutron radiation."

Subp. 2. **Attenuation.** "Attenuation" means the reduction of exposure rate upon passage of radiation through matter.

Subp. 3. [Repealed by amendment, L 1977 c 305 s 39]

Subp. 4. **Collimation.** "Collimation" means the restriction of the useful beam to an appropriate area.

Subp. 5. **Commissioner.** "Commissioner" means the commissioner of the Minnesota Department of Health.

Subp. 6. **Controlled area.** "Controlled area" means a defined area in which the exposure of persons to radiation is under the supervision of a radiation protection supervisor. (This implies that a controlled area is one that requires control of access, occupancy, and working conditions for radiation protection purposes.)

Subp. 7. **Curie (Ci).** "Curie (Ci)" means the special unit of activity equal to a disintegration rate of 37 billion disintegrations per second. One millicurie (mCi) equals 0.001 curie; one microcurie (uCi) equals 0.000001 curie.

Subp. 8. **Dead-man switch.** "Dead-man switch" means a switch so con-

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structed that a circuit-closing contact can be maintained only by continuous pressure on the switch.

Subp. 9. **Diagnostic-type protective tube housing.** "Diagnostic-type protective tube housing" means an X-ray tube housing so constructed that the leakage radiation measured at a distance of one meter from the source cannot exceed 100 milliroentgens in one hour when the tube is operated at its maximum continuous rated current for the maximum rated tube potential.

Subp. 10. **Dose equivalent (DE).** "Dose equivalent (DE)" means a quantity used for radiation protection purposes that expresses on a common scale for all radiations the irradiation incurred by exposed persons. It is defined as the product of the absorbed dose in rads and certain modifying factors. The unit of dose equivalent is the rem. (The modifying factors are: 1 for gamma and X rays and beta particles; ten for alpha particles and for neutrons; ten for protons with energies up to ten million electron volts; 20 for heavy ions.

For X and gamma rays, the dose in rems may be assumed to be numerically equivalent to the exposure in roentgens and the absorbed dose in rads.)

Subp. 11. **Filter-filtration.** "Filter-filtration" means material in the useful beam which absorbs preferentially the less penetrating radiation.

Subp. 12. **Half-value layer (HVL).** "Half-value layer (HVL)" means the thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the exposure rate by one-half.

Subp. 13. **Healing arts.** "Healing arts" means health professions for diagnostic and/or healing treatment of human and animal maladies including but not limited to the following which are duly licensed by the state of Minnesota for the lawful practice of: medicine and its associated specialties, dentistry, veterinary medicine, osteopathy, chiropractic, and podiatry.

Subp. 14. **High radiation area.** "High radiation area" means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

Subp. 15. **Industrial radiographer.** "Industrial radiographer" means any individual who performs or who, in attendance at the site where sources of radiation are being used, personally supervises industrial radiographic operations and who is responsible to the registrant for assuring compliance with the requirements of these rules.

Subp. 16. **Industrial radiography.** "Industrial radiography" means the examination of the macroscopic structure of materials by nondestructive methods utilizing sources of radiation.

Subp. 17. **Inherent filter.** "Inherent filter" means the filter permanently in the useful beam; it includes the window of the X-ray tube and any permanent tube or source enclosure.

Subp. 18. **Interlock.** "Interlock" means a device which automatically causes a reduction of the exposure rate upon entry by personnel into a high radiation area. Alternatively, an interlock may prevent entry into a high radiation area.

Subp. 19. **Ionizing radiation.** "Ionizing radiation," see radiation.

Subp. 20. **Iso-line.** "Iso-line" means a line, usually irregular, along which the exposure rates are the same at any point.

Subp. 21. **Kilovolt peak (kVp).** "Kilovolt peak (kVp)" means the crest value in kilovolts of the potential difference of a pulsating potential generator. When only one half of the wave is used, the value refers to the useful half of the cycle.

Subp. 22. **Lead equivalence.** "Lead equivalence" means the thickness of lead affording the same attenuation, under specified conditions, as the material in question.

Subp. 23. **Leakage radiation.** "Leakage radiation," see radiation.

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Subp. 24. **Maximum permissible concentrations (MPC).** "Maximum permissible concentrations (MPC)" means those amounts listed as maximum permissible concentrations in Handbook 69, Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure, U.S. Department of Commerce, National Bureau of Standards, June 5, 1959.

Subp. 25. **Maximum permissible dose or dose equivalent (MPD).** "Maximum permissible dose" or "dose equivalent (MPD)" means for radiation protection purposes, the maximum dose equivalents that persons shall be allowed to receive in a stated period of time (see part 4730.3300). This excludes patients receiving radiation for diagnostic or therapeutic purposes under supervision of licensed practitioners of the healing arts.

Subp. 26. **Maximum permissible neutron radiation.** "Maximum permissible neutron radiation" means the amount of neutron radiation in rems that is equivalent to the maximum permissible dose. Neutron flux dose equivalents are given in part 4730.3400.

Subp. 27. **One general site.** "One general site" means the building or adjacent buildings at the same address in which the sources of ionizing radiation for the registrant are located.

Subp. 28. **Person.** "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this state, and any legal successor, representative, agent or agency of the foregoing, but not federal government agencies.

Subp. 29. **Personnel monitor.** "Personnel monitor" means an appropriately sensitive device used to estimate the radiation exposure of an individual, (e.g., film badges, pocket chambers, pocket dosimeters, film rings, thermo-luminescent dosimeters, and other devices having the same purpose).

Subp. 30. **Picocurie.** "Picocurie" means a micromicrocurie or that quantity of radioactive material which decays at the rate of 2.2 disintegrations per minute.

Subp. 31. **Primary beam.** "Primary beam," see radiation: useful beam.

Subp. 32. **Primary protective barrier.** "Primary protective barrier," see protective barrier.

Subp. 33. **Protective apron.** "Protective apron" means an apron made of radiation absorbing materials, used to reduce radiation exposure.

Subp. 34. **Protective barrier.** "Protective barrier" means a barrier of radiation absorbing material(s) used to reduce radiation exposure.

A. Primary protective barrier means a barrier sufficient to attenuate the useful beam to the required degree.

B. Screening means the testing with X-ray machines of human beings or human population groups for the detection or evaluation of health conditions when such X-ray tests are not specifically and individually ordered by a licensed healing arts practitioner, legally authorized to order such X-ray tests, for the purpose of diagnosis or treatment or as part of a physical examination conducted by a licensed practitioner. Screening does not include research protocols utilizing X-ray procedures when such protocols are part of research projects sponsored or financed by agencies of the federal government, conducted by educational institutions training practitioners of the healing arts or, conducted in hospitals, when such research is authorized by or under control of the governing body of that hospital.

C. Secondary protective barrier means a barrier sufficient to attenuate stray radiation to the required degree.

Subp. 35. **Protective glove.** "Protective glove" means a glove made of radiation-absorbing materials used to reduce radiation exposure.

Subp. 36. **Rad.** "Rad" means a special unit of absorbed dose equal to 100 ergs per gram. One millirad (mrad) equals 0.001 rad.

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Subp. 37. **Radiation (ionizing).** "Radiation (ionizing)" means any electromagnetic or particulate radiation capable of producing ions directly or indirectly, by interaction with matter. (This includes gamma rays and X rays, alpha and beta particles, high-speed electrons, neutrons, protons, and other nuclear particles, but does not include sound or radio waves, or visible, infrared, or ultraviolet light.)

A. "Leakage radiation" means all radiation coming from within the source or tube housing except the useful beam. (Note: "Leakage radiation" includes the portion of the direct radiation not absorbed by the protective source or tube housing as well as the scattered radiation produced within the housing.)

B. "Scattered radiation" means radiation that, during passage through matter, has been deviated in direction. (It may have been modified also by a decrease in energy.)

C. "Secondary radiation" means radiation emitted by an irradiated material such as bone or tissue and all inanimate objects.

D. "Stray radiation" means the sum of leakage and scattered radiation.

E. "Useful beam" means radiation which passes through the window, aperture, cone, or other collimating device of the source housing. Sometimes called "primary beam."

Subp. 38. **Radiation hazard.** "Radiation hazard" means a condition under which persons might receive radiation in excess of the maximum permissible dose.

Subp. 39. **Radiation machine.** "Radiation machine" means any device capable of producing radiation except devices which produce radiation only from radioactive material.

Subp. 40. **Radiation protection.** "Radiation protection" means the use of shielding, protective clothing, protective equipment, and other means to eliminate or reduce exposure to ionizing radiation.

Subp. 41. **Radiation protection survey.** "Radiation protection survey," see survey.

Subp. 42. **Radiation safety.** "Radiation safety" means a condition assumed to exist when following a policy of minimization the doses of radiation are eliminated or reduced to the lowest practicable amount and are less than those shown under the definitions of maximum permissible concentrations, maximum permissible doses, and maximum permissible neutron radiation.

Subp. 43. **Radioactive material.** "Radioactive material" means any solid, liquid, or gaseous substance which emits radiation spontaneously.

Subp. 44. **Radiographic exposure device.** "Radiographic exposure device" means any device containing a sealed source, fastened or contained therein in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to an unshielded position for purposes of making a radiographic exposure.

Subp. 45. **Registrant.** "Registrant" means a person having possession of any source of ionizing radiation except those specifically exempted under part 4730.0400 or 4730.0700, who has complied with part 4730.0400.

Subp. 46. **Rem.** "Rem" means the unit of dose equivalent. One millirem (mrem) equals 0.001 rem.

Subp. 47. **Restricted area.** "Restricted area" means any area to which access or egress may be limited by the registrant for purposes of protection of individuals from exposure to radiation and radioactive materials.

Subp. 48. **Roentgen (R).** "Roentgen (R)" means a special unit of exposure equal to 2.58×10^{-4} coulomb per kilogram of air. One milliroentgen (mR) equals 0.001 roentgen.

Subp. 49. **Scattered radiation.** "Scattered radiation," see radiation.

Subp. 50. **Secondary protective barrier.** "Secondary protective barrier," see protective barrier.

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Subp. 51. **Secondary radiation.** "Secondary radiation," see radiation.

Subp. 52. **Source.** "Source" means a discrete amount of radioactive material or the target (focal spot) of the X-ray tube.

Subp. 53. **Storage container.** "Storage container" means a device in which sources are transported or stored.

Subp. 54. **Stray radiation.** "Stray radiation," see radiation.

Subp. 55. **Survey.** "Survey" means an evaluation of the adequacy of radiation protection and assessment of the situation incident to the production, use, release, disposal, or presence of sources of ionizing radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present in and around the installation.

Subp. 56. **Television receiver.** "Television receiver" means an electronic product designed to receive and display a television picture through broadcast, cable, or closed-circuit television.

Subp. 57. **Therapeutic-type protective tube housing.** Therapeutic-type tube housing:

A. For X-ray therapy equipment not capable of operating at 500 kilovolt peak (kVp) or above, the following definition applies: An X-ray tube housing so constructed that the leakage radiation at a distance of one meter from the source does not exceed one roentgen in an hour when the tube is operated at its maximum rated continuous current for the maximum rated tube potential.

B. For X-ray therapy equipment capable of operation at 500 kilovolt peak (kVp) or above, the following definition applies: An X-ray tube housing so constructed that leakage radiation at a distance of one meter from the source does not exceed either one roentgen in an hour or 0.1 percent of the useful beam dose rate at one meter from the source, whichever is greater, when the machine is operated at its maximum rated continuous current for the maximum rated accelerating potential.

C. In either case, small areas of reduced protection are acceptable provided the average reading over any 100 square centimeters area at one meter distance from the source does not exceed the values given above.

Subp. 58. **Unit of exposure.** "Unit of exposure" means the roentgen.

Subp. 59. **Unit of radioactivity.** "Unit of radioactivity" means the curie.

Subp. 60. **Units of radiation dose.** "Units of radiation dose" means the rad (unit of absorbed dose) and the rem (radiation to body tissues in terms of its estimated biological effect relative to an exposure of one roentgen of X ray).

Subp. 61. **Useful beam.** "Useful beam," see radiation.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.0200 PURPOSE AND SCOPE.

Whereas, ionizing radiation can be instrumental in the improvement of health, welfare, and productivity of the public if properly utilized, and may impair the health of the people and the industrial and agricultural potentials of the state if improperly utilized, and the commissioner of health has the statutory authority and duty to adopt, alter, and enforce regulations for the preservation of the public health and thereby to control sources of ionizing radiation and the handling, storage, transportation, use, and disposal of radioactive isotopes and fissionable materials within this state, and to observe their effect upon human health, it is hereby declared to be the purpose of the commissioner of health in parts 4730.0100 to 4730.3600 to secure information concerning the nature and extent of the employment of radiation-emitting equipment and radioactive materials within this state, and to control or prevent dangers to health from ionizing radiation without limiting or interfering with the constructive uses of radiation

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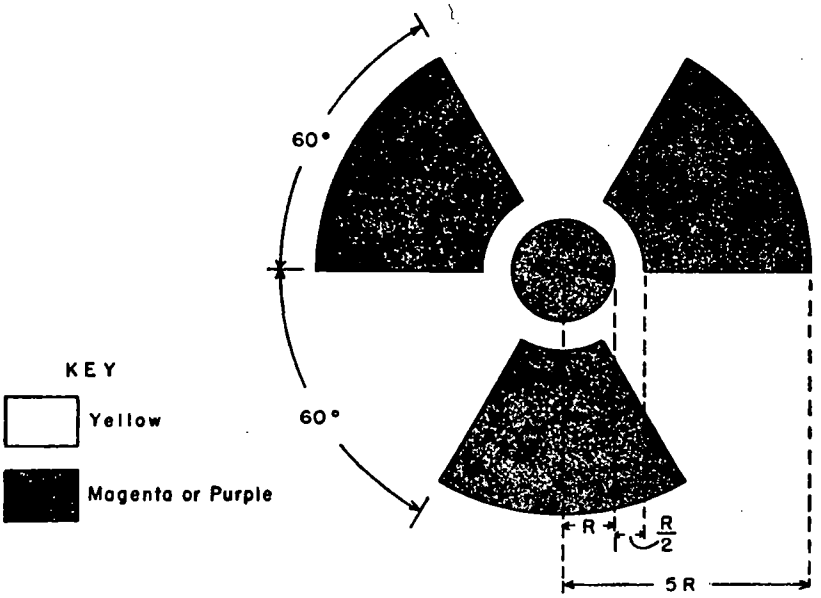
consistent with a policy of reducing radiation exposure to persons and the general public by all practical means. The scope of parts 4730.0100 to 4730.3600 does not include, except for the provision of registration, those sources of ionizing radiation known as by-product materials, source materials, or special nuclear material.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.0300 PRECAUTIONARY PROCEDURES.

Subpart 1. **Radiation symbol and labeling.** Each radiation sign or label shall bear the standard symbol specified in these rules and the specified printed warning in capital block letters. The warning CAUTION RADIATION AREA or DANGER RADIATION AREA shall appear on signs in an area in which a radiation hazard may exist. The warning CAUTION, RADIOACTIVE MATERIAL(S) or DANGER, RADIOACTIVE MATERIAL(S) shall appear on containers containing radioactive materials greater than the applicable quantities listed in parts 4730.3500 and 4730.3600. The standard symbol for designating any radiation hazard shall be a circle with three propeller-like blades arranged around it as illustrated:



The boundaries of the three blades of the propeller-like symbol shall be confined within a 60-degree sector of the circle delineated by their outer edges, and said blades shall be symmetrically distributed 60 degrees apart. The radius (R) of the central circle of the symbol shall be the standard for its other dimensions as follows: Overall radius of symbol = 5R, shortest distance from circumference of central circle to inner edge of nearest blade = R/2. The standard color specifications shall be a background of yellow with lettering and distinctive symbol in magenta or purple. The symbol and lettering shall be as large as practical, consistent with the size of the equipment or material upon which they appear.

Subp. 2. **Prohibitions on use of symbol.** The use of the specified radiation symbol for any other purpose than designating or referring to an area of detectable radiation is expressly prohibited.

Subp. 3. **Placement of symbol and labels.** All containers of radioactive materi-

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al for storage and disposal, storage areas, work areas, and other normally occupied areas where a radiation hazard may exist shall be conspicuously posted with radiation warning labels. Conspicuous radiation warning labels shall be posted in areas which are not readily accessible and may be only occasionally occupied but in which a radiation hazard may exist. Readily accessible areas in which a radiation hazard may exist shall be suitably delineated and conspicuously posted with radiation warning labels. This applies even if the area is not normally occupied. All radiation-hazard labels posted when a radiation hazard existed shall be removed when the hazard is no longer present.

Subp. 4. **Personnel monitoring.** Each registrant shall supply appropriate personnel monitoring equipment to, and shall require the use of, such equipment by:

A. each individual, except a patient, who enters a restricted area under such circumstances that he or she receives, or is likely to receive, a dose in excess of one quarter of the maximum permissible dose as defined in these rule; and

B. each individual who enters a high radiation area.

Records of exposures shall be maintained permanently by the registrant.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

REGISTRATION

4730.0400 REGISTRATION REQUIREMENTS.

The owner or person having possession of any source of ionizing radiation except those specifically exempted under this part or under part 4730.0800 or in the case of nuclear facilities which are registered in accordance with special procedures required by part 4730.3000, shall:

A. Register such sources with the commissioner of health within 30 days of its acquisition upon forms prescribed and provided for that purpose.

B. Designate an individual who will be responsible for radiation protection from the source. Such individual, the radiation protection officer, shall:

(1) be qualified by training and experience concerning all hazards and precautions involved in operating or in using the source for which he is responsible;

(2) establish a detailed program of radiation safety for effective compliance with the applicable requirements of parts 4730.0100 to 4730.3600;

(3) give instructions concerning hazards and safety practices to individuals under his supervision who may be exposed to radiation from the source; and

(4) make surveys and carry out other procedures as required by parts 4730.0100 to 4730.3600.

When, in the opinion of the commissioner of health, the individual designated to be responsible for radiation safety does not have qualifications sufficient to insure safe operating or using of the source, the commissioner of health may require the registrant to designate another individual who meets the requirements of item B.

C. Every hospital in which radioisotopes are used shall have a committee which coordinates the use of radioisotopes within the hospital and assures the radiation safety of the patients and personnel involved during the use of these isotopes.

D. The registrant shall notify the commissioner of health within 30 days of any change in the ownership or disposition of registered sources.

E. No person in any advertisement shall refer to the fact that a source is registered with the commissioner of health, and no person shall state or imply that any activity under such registration has been approved by the commissioner of health.

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F. The registrant shall be subject to all applicable requirements of parts 4730.0100 to 4730.3600.

G. The registration requirements shall not apply to facilities subject to part 4730.3000, nor to sources or conditions exempted under part 4730.0800, nor to by-product materials, source materials, or special nuclear materials licensed by the U.S. Atomic Energy Commission not in excess of the kind and quantity specified in parts 4730.3500 and 4730.3600.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.0500 RENEWAL OF REGISTRATION.

Each registration pursuant to parts 4730.0100 to 4730.3600 shall be renewed biennially during the month of January of odd-numbered years so long as the activity requiring registration continues. If there has been no substantial change in the matters described in the last prior registration or renewal, the renewal of the registration shall so state. If there has been any accession of additional radiation sources or other substantial change in the matters described in the preceding registration or renewal, the renewal shall state the accession or other change and give the information relating to such accession or other change that would be required upon original registration.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.0600 REGISTRATION FEES.

Subpart 1. **Fee for initial or renewal registration.** The initial or renewal biennial registration of every source of ionizing radiation required to be registered by parts 4730.0400 to 4730.0800 shall be accompanied by a fee as prescribed herein. The fee shall be based upon the number of X-ray tubes and facilities using radium registered by each person, company, hospital, group, practice, or other organization or association at one general site as follows:

Type of Source	Charge per Tube First Five Tubes	Charge per Tube 6th Tube or More
Dental X-ray	$ 25	$ 10
Medical[1] industrial or educational[2] X-ray	40	10
Linear accelerator	50	
Radium/per facility	100	
Inspection surcharge for any X-ray or accelerator facility	40	
Maximum fee per facility	500	

[1] Medical source means X-ray equipment used by any licensed practitioner of the healing arts and facilities with which they are associated, but does not include sources used by dentists.

[2] Industrial or educational source means X-ray equipment used in an industrial or educational facility.

Subp. 2. **Penalty fee.** Applications for initial or renewal registrations submitted to the commissioner of health after the time specified by parts 4730.0400, item A; 4730.0500; and this part shall be accompanied by a penalty fee of $15 in addition to the fee prescribed in subpart 1.

Subp. 3. **Fee for sources requiring registration during last three months of a biennial registration.** The initial registration fee for any source of ionizing radiation required to be registered during the last three months of a biennial registration period shall be $10 per X-ray tube up to a maximum of 16 tubes and $20 for each facility using radium. The inspection surcharge for any X-ray or acceler-

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ator facility shall be $10. The penalty fees as specified in subpart 2 shall apply to this subpart. This provision shall not apply to any application for registration which should have been submitted to the commissioner of health in a timely manner prior to the last three months of a registration period.

Statutory Authority: *MS s 144.121*

History: *L 1977 c 305 s 39; 10 SR 1687*

4730.0700 RECORDS, INSPECTIONS, AND TESTS.

Subpart 1. **Requirements for recordkeeping.** Each registrant shall keep records showing the receipt, transfer, and disposal of all sources of radiation subject to these and all other state and federal regulations.

Subp. 2. **Opportunity to inspect.** Each owner, renter, or other person in possession of a source of radiation subject to registration or exempted under part 4730.0400 or 4730.0800 shall afford agents of the commissioner of health, at all reasonable times, opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored, and shall make available to the agent, upon reasonable notice, records maintained pursuant to these regulations.

Subp. 3. **Periodic testing requirements.** Each owner, renter, or other person in possession of a source of radiation shall perform or cause to be performed such reasonable procedures as are necessary to assure radiation safety including, but not limited to, tests of:

A. sources of radiation;

B. facilities wherein sources of radiation are used or stored; and

C. radiation detectors, monitoring instruments, and other equipment and devices used in connection with utilization or storage of sources of radiation.

Results of such tests shall be available for submission to the commissioner of health when requested.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.0800 EXEMPTIONS.

Parts 4730.0100 to 4730.3600 shall not apply to the following sources or conditions:

A. natural radioactive materials of an equivalent specific radioactivity not exceeding that of natural potassium;

B. timepieces, instruments, or devices containing self-luminous elements, except during manufacture or repair of the self-luminous elements themselves;

C. electrical equipment that is not intended primarily to produce radiation and that, by nature of design, does not produce radiation at the point of nearest approach at a weekly rate higher than one-tenth of the appropriate limit for any critical organ exposed. The production testing or production servicing of such equipment shall not be exempt;

D. a radiation machine not being used in a manner such that it produces radiation;

E. domestic television receivers, provided the dose rate at 5 cm from any outer surface of ten cm^2 is less than 0.5 mrem per hour;

F. any radioactive material being transported in conformity with regulations adopted by the United States Department of Transportation and other agencies of the United States having jurisdiction;

G. any quantities of thorium contained in: incandescent gas mantles; vacuum tubes; welding rods; electric lamps for illuminating purposes provided

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that each lamp does not contain more than 50 milligrams of thorium; germicidal lamps, sunlamps, and lamps for outdoor or industrial lighting provided that each lamp does not contain more than two grams of thorium; and rare earth metals and compounds, mixtures, and products containing not more than 0.25 percent by weight thorium, uranium, or any combination of these.

H. radiation sources specifically designated by the commissioner of health as exempt by virtue of being known to be without hazard to health.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.0900 VENDOR RESPONSIBILITY.

Subpart 1. **Generally.** No person shall make, sell, lease, transfer, lend, or install X-ray or fluoroscopic equipment or the supplies used in connection with such equipment unless such supplies and equipment, when properly placed in operation and properly used, will meet the requirements of parts 4730.0100 to 4730.3600. This includes, but is not restricted to, responsibility for the delivery of cones or collimators, filters, adequate timers, and fluoroscopic shutters (where applicable).

Subp. 2. **Notification requirements.** Persons selling, leasing, or transferring registerable sources of radiation shall notify the commissioner of health in writing within 30 days of such sale, lease, or transfer, and shall supply the name and address of the purchaser and such pertinent information as is requested by the commissioner of health.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.1000 TRANSPORTATION.

Subpart 1. **Scope.** The provisions of this part apply to the transportation of radioactive materials or the delivery of radioactive material to a carrier for transportation, not subject to the rules and regulations of the United States Department of Transportation and other agencies of the United States having jurisdiction.

Subp. 2. **Prohibition.** No person shall transport any radioactive material outside the confines of the facility or other authorized location of use, or deliver any radioactive material to a carrier for transportation, unless the person complies with all requirements, appropriate to the mode of transportation, relating to the packaging of the radioactive material and to the marking and labeling of the package and transporting vehicle, of the rules and regulations, published by the United States Department of Transportation (Code of Federal Regulations, title 46, part 146, Code of Federal Regulations, title 49, parts 173 to 179, and Code of Federal Regulations, title 14, part 103) to the same extent as if the transportation were subject to the rules and regulations of that agency.

Statutory Authority: *MS s 144.12 subd 1*

4730.1100 NOTIFICATION OF INCIDENTS AND LOST SOURCES.

Subpart 1. **Immediate notification.** The owner, operator, radiation safety officer, or the person in charge of the radiation source shall immediately notify the commissioner of health by telephone or telegraph of any incident involving registered sources of ionizing radiation which may have caused, or threatens to cause:

A. a dose equivalent to the whole body of any individual of 25 rems or more of radiation;

B. a dose equivalent to the skin of the whole body of any individual of 150 rems or more of radiation; or

C. a dose equivalent to the feet, ankles, hands, or forearms of any individual of 375 rems or more of radiation.

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Subp. 2. **Twenty-four hour notification.** The owner, operator, radiation safety officer, or the person in charge of the radiation source shall within 24 hours notify the commissioner of health by telephone or telegraph of any incident involving registered sources of ionizing radiation which may have caused, or threatens to cause:

A. a dose equivalent to the whole body of any individual of 5 rems or more of radiation;

B. a dose equivalent to the skin of the whole body of any individual of 30 rems or more of radiation; or

C. a dose equivalent to the feet, ankles, hands, or forearms of any individual of 75 rems or more of radiation.

Subp. 3. **Theft or loss.** When a theft or loss of a radiation source occurs, the owner, operator, radiation safety officer, or the person in charge shall notify the commissioner of health by telephone immediately upon discovery of the situation and shall report all known facts and circumstances relating to the occurrence in writing within seven days thereafter. The owner shall notify the commissioner of health of actions taken to recover the stolen or lost source and shall report any substantive additional information on the loss or theft which becomes available to the registrant within 30 days after he learns of such information.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.1200 PROHIBITED USES OF RADIATION.

Subpart 1. **Prohibition of shoe-fitting fluoroscopic device.** Because of the public health hazard involved in the indiscriminate use of radiation, it is hereby prohibited for any person to operate or maintain within the state any shoe-fitting fluoroscopic device.

Subp. 2. **Radiation not to be used for training.** Radiation shall not be applied to a person for the purpose of instruction or training.

Subp. 3. **Qualified personnel.** Only those individuals who are licensed practitioners of the healing arts, or individuals that are qualified by training and experience and are under the direct supervision of a licensed practitioner of the healing arts, may intentionally apply radiation to a person.

Subp. 4. **No screening without permission of commissioner.** The use of X-ray machines for the purpose of screening is prohibited without prior written approval of the commissioner.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.1300 COMMISSIONER APPROVAL OF SCREENING.

Subpart 1. **Criteria.** Any person desiring commissioner approval for screening purposes as specified in part 4730.1200, subpart 4 shall submit an application to the commissioner requesting his permission to perform screening. The burden of justifying the requested screening rests on the applicant. Approval will be granted if the commissioner is satisfied that:

A. the proposed screening is a justified public health measure;

B. the benefit derived from the proposed screening will outweigh the detriment of X-ray exposure; and

C. the X-ray screening will be conducted properly, safely, and legally, i.e., in accordance with all applicable statutes and rules of the state of Minnesota or federal government.

Subp. 2. **Content of application.** The application for approval of a screening program must contain the following information and data:

A. Name and Minnesota business address. If the applicant is a corporation or other business or nonbusiness association, the name of the person repre-

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senting the association shall be given. If the applicant's principal location or home office is not in Minnesota, the principal location or home office address shall be given as well as the name of the person who may be contacted by the commissioner with respect to the application. If the applicant is a foreign corporation subject to the provisions of Minnesota Statutes, chapter 303 it shall submit a certified copy of its certificate of authority issued by the Minnesota secretary of state. The certification shall be dated no more than one month prior to the date of submission of the application to the commissioner.

B. When and where the proposed screening is to be performed.

C. Description of the specific screening proposed.

D. Description of the age distribution of the population to be screened.

E. The amount of X-ray exposure to which individuals will be subjected by the proposed screening:

(1) Applications for screening for pulmonary (lung) conditions shall not be approved if the incident (skin entrance) X-ray exposure will exceed 50 milliroentgens per radiograph for the posterior-anterior (PA) view. Using normally accepted exposure techniques, a Victoreen R-chamber placed at a distance of 11 inches from the center of the film with a scatter phantom (Alderson "Rando" phantom or equivalent) positioned in front of the center of the film, or an equivalent method, shall be the method used for measuring the incident (skin entrance) exposure.

(2) Commonly accepted state-of-the-art techniques and equipment shall be the methods used for measuring X-ray exposure from other types of screening. A written description of the specific method used shall be submitted to the commissioner. The amount of X-ray exposure shall be specified as skin entrance or film exposure and shall not exceed amounts normally given during such projections based on the studies "Population Exposure to X-Rays U. S. 1970" (DHEW Publication (FDA) 73-8047, November 1973) and "National Evaluation of X-Ray Trends: Tabulation of Data for 'All States' for Period January 1, 1974 to December 31, 1974."

The estimated mean exposure per film by type of radiographic examination specified in this publication is reproduced in part 4730.1650.

The weighted mean indexes by type of exam/projection specified in this publication are reproduced in part 4730.1660.

F. Why the screening is being planned. A detailed statement shall specify the compelling health reasons, health benefits, or health emergency which justifies the radiation exposure to which individuals will be subjected by the proposed screening.

G. Who will interpret the X-ray film and to whom will the results, interpretation, or findings be sent.

H. Where the X-ray film will be filed.

I. Who will have access to the X-ray film.

J. If the persons screened will not be given the X-ray film or will not be personally informed by the applicant of the results, interpretation, or findings:

(1) How will this information be communicated to those individuals who have been screened.

(2) What arrangements will be made to assure that those persons who have been screened will be informed as to the need for further medical and health care evaluation or treatment.

K. Why alternate screening methods, not requiring the use of X-ray machines, are not acceptable.

L. Who will conduct the screening (operators) and their qualifications, with complete information pertaining to the operators including their formal training and specifically describing any licenses, registration or other authority

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held from Minnesota or other state or federal agencies or professional associations.

M. Who will supervise the operators conducting the screening, with complete information pertaining to the supervisor's qualifications and specifically describing any licenses, registration, or other authority held from Minnesota or other state or federal agencies or professional associations. The method of supervision shall be specified.

N. What equipment will be used in connection with the screening, and whether it complies with Minnesota law and regulations and whether such equipment has been inspected, licensed, or approved in any other way by a Minnesota agency, or by any other state or federal agency.

O. Any other information requested by the commissioner which he deems necessary to enable him to determine whether or not the proposed X-ray exposure the subjects of the screening will receive is a justified public health measure, the benefit of which outweighs the potential detriment of X-ray exposure. The commissioner may request the submission of additional information and data subsequent to the submission of the original application. The commissioner may deny approval of any request to perform screening as specified in part 4730.1200, subpart 4 if the applicant fails to or refuses to submit all requested data.

Subp. 3. **Approval of changes in screening program.** It is the responsibility of the applicant to inform the commissioner of any changes in its screening program from that which is described in the application and receive commissioner approval of such changes prior to commencement of the screening program.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.1400 VIOLATIONS.

Subpart 1. **Prohibition of violation.** If in the opinion of the commissioner, it is necessary to do so to protect persons from hazards of radiation, an injunction or other court order may be obtained prohibiting any violation of any provision of any regulation or order issued thereunder. Any person who willfully violates any provision of any regulation or order issued thereunder may be guilty of a crime, and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

Subp. 2. **Commissioner approved screening.** The commissioner or his representative may inspect the screening program while in progress to assure that it is being carried out as described in the application and in compliance with parts 4730.0100 to 4730.3600 relating to ionizing radiation.

Subp. 3. **Withdrawal of approval for conditions allowing overexposure.** Approval may be withdrawn immediately if after an inspection the commissioner finds the existence of conditions which would result in serious overexposure. All screening procedures shall be terminated immediately upon receipt of the written notice of existence of such overexposure. The applicant may request a contested case hearing within five days after receipt of the notice, provided, however, the request for hearing does not stay the commissioner's order of immediate cessation of the screening program. The hearing shall be scheduled within ten days of receipt of the request for the hearing.

Subp. 4. **Withdrawal of approval for noncompliance with application.** Approval may be withdrawn if after an inspection the commissioner finds discrepancies between the screening program as implemented and as described in the application or for violation of parts 4730.0100 to 4730.3600 relating to ionizing radiation. A hearing shall be held if requested by the applicant within three days after the receipt of the notice of withdrawal of approval. The hearing may be held upon granting the applicant three days' notice. If a hearing is requested, withdrawal of approval shall not take effect until a final order is issued by the commissioner.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

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4730.1500 REGISTRANT'S SAFETY REQUIREMENTS.

Safety and precaution:

A. The registrant shall assure himself that each individual operating X-ray equipment under his control is thoroughly conversant with the recommendations of the National Council on Radiation Protection and Measurements pertaining to X rays, currently found in NCRP Report Number 33, "Medical X-Ray and Gamma-Ray Protection for Energies up to 10 MeV," issued February 1, 1968, NCRP Report No. 35, "Dental X-Ray Protection," issued March 9, 1970, NCRP Report No. 36, "Radiation Protection in Veterinary Medicine," issued August 15, 1970, and where applicable National Bureau of Standards Handbook 93, "Safety Standard for Non-Medical X-Ray and Sealed Gamma-Ray Sources," issued January 3, 1964.

B. The registrant shall provide safety rules to each individual operating X-ray equipment under his control, including any restrictions of the operating technique required for the safe operation of the particular X-ray apparatus, and shall require that the operator demonstrate familiarity with parts 4730.0100 to 4730.3600.

C. The amount of ionizing radiation that may be applied to a person for diagnostic purposes shall be the minimum required to obtain the clinical information desired.

D. The darkroom for film development shall be light-tight.

Statutory Authority: *MS s 144.121*

4730.1600 REQUIREMENTS FOR SHIELDING IN INSTALLATIONS.

Shielding:

A. Each installation where radiation is used shall be provided with such primary barriers and/or secondary barriers as are necessary to assure radiation safety. Each installation shall comply with the special shielding requirements applicable to the type of installation under consideration as specified in subsequent parts of these rules. Primary and/or secondary barrier requirements shall be deemed to be met if the thicknesses of such barriers are equivalent to those as computed in accordance with Appendix C, NCRP Report No. 34, "Medical X-Ray and Gamma-Ray Protection for Energies Up to 10 MeV," National Council on Radiation Protection and Measurement, March 2, 1970, and where applicable, National Bureau of Standards Handbook 93, "Safety Standard for Non-Medical X-Ray and Sealed Gamma-Ray Sources," issued January 3, 1964.

B. Lead barriers shall be mounted in such a manner that they will not sag or cold-flow because of their own weight and shall be protected against mechanical damage.

C. Joints between different kinds of protective materials shall be so designed that the overall protection of the barrier is not impaired.

D. Holes in protective barriers shall be covered so that the overall attenuation is not impaired.

E. Windows, window frames, doors, and door frames shall have the same lead equivalent as that required of the adjacent wall.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.1650 APPENDIX A: POPULATION EXPOSURE TO X RAYS U.S. 1970; ESTIMATED MEAN EXPOSURE PER FILM BY TYPE OF RADIOGRAPHIC EXAMINATION.

Type of Examination	Milliroentgens (at skin entrance)
Head and Neck	300

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skull	330
cervical spine	240
examinations of head and neck, n.e.c.	330
Thorax	(not given)
chest, photofluorographic	(not given)
chest, radiographic	44
shoulder	260
thoracic spine and cervical spine	980
exams of chest or thorax, n.e.c.	1,520
Abdomen	960
Upper abdomen	960
cholecystography or cholangiogram	620
lumbar spine or dorsolumbar spine	1,920
upper gastrointestinal series	710
gastrointestinal, n.e.c.	920
upper abdomen, n.e.c.	1,240
Lower abdomen	970
barium enema	1,320
abdomen, KUB, flat plate	670
intra or retrograde pyelogram	590
pelvis or lumbo-pelvic	610
lumbosacral or sacral spine	2,180
hip	560
lower abdomen, n.e.c.	850
Extremities	100
Upper extremities	90
hand and/or wrist	100
forearm or elbow	60
upper extremities, n.e.c.	90
Lower extremities	110
ankle	140
foot and toes or heel	120
knee	110
tibia and fibula	40
femur or entire leg	120
lower extremities, n.e.c.	140
More than one body area	500

Statutory Authority: *MS s 144.121*

4730.1660 APPENDIX B; NATIONWIDE EVALUATION OF X-RAY TRENDS; WEIGHTED MEAN INDEXES BY TYPE OF EXAM/PROJECTION.

Type of exam/projection	Exposure at skin entrance (mR)
Chest (P/A)	23.0
Skull (Lateral)	276.0
ABD. (KUB) (A/P)	652.9
Retr. Pyelo. (A/P)	847.9
Thor. Spine (A/P)	851.3
Cervical Spine (A/P)	302.9
Lum - Sac Spine (A/P)	888.6
Full Spine (A/P)	306.6
Feet (D/P)	202.5
Dental B.W. Post	506.8
Dental Periapical	698.3
Dental Ceph. (Lateral)	31.8

Statutory Authority: *MS s 144.121*

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X-RAY USES

4730.1700 HEALING ARTS.

Subpart 1. **Fluoroscopic equipment.** Fluoroscopic equipment:

A. The protective tube housing shall be of the diagnostic type.

B. The target-to-panel or target-to-tabletop distance shall not be less than 12 inches.

C. The exposure switch shall be of the dead-man type.

D. A manually reset cumulative timing device activated by the fluoroscope exposure switch shall be used which will either indicate elapsed time by an audible signal or turn off the apparatus when the total exposure exceeds a predetermined limit in one or in a series of exposures not exceeding five minutes.

E. The total filtration permanently in the useful beam shall not be less than 2.5 millimeters aluminum equivalent. When the tabletop or panel surface is interposed between the source and the patient, its aluminum equivalent may be included as part of the total filtration. This requirement shall be assumed to have been met if the half-value layer is not less than that shown in the following table:

Operating Voltage (kVp)	Half-Value Layer (millimeters aluminum)
80	2.4
90	2.6
100	2.8
120	3.1

F. The useful beam shall be attenuated by a primary barrier which shall be either:

(1) The fluoroscopic screen glass and frame which shall be the equivalent of 1.5 millimeters of lead shielding for voltages up to 100 kilovolts peak, 1.8 millimeters of lead shielding for voltages greater than 100 kilovolts peak but less than 125 kilovolts peak, and 2.0 millimeters for voltages 125 kilovolts peak or greater.

(2) The image intensification mechanism.

G. Collimators shall be provided to restrict the size of the useful beam to less than the area of the primary barrier, irrespective of the panel-to-screen distance. During fluoroscopy with image intensifiers, the useful beam shall not exceed the diameter of the input phosphor. Collimators, adjustable diaphragms, and shutters shall provide the same degree of protection as is required of the tube housing.

H. The tube mounting and the primary barrier shall be so linked together that the barrier always intercepts the useful beam. Exposure shall terminate if the primary barrier is removed from the useful beam. The unit shall be nonoperable without the primary barrier in place.

I. The screen shall be protected by a light-proof and dust-proof cover when the screen is not in use.

J. A shielding device of at least 0.25 millimeter lead equivalent for covering the bucky slot during fluoroscopy shall be provided.

K. Devices which indicate the X-ray tube potential and current shall be provided.

L. Flexible leaded flaps which are the equivalent of 0.25 millimeter of lead shielding and which are hung from the screen shall be provided. The fluoroscopist shall wear a lead apron which is the equivalent of 0.25 millimeter of lead shielding.

Subp. 2. **Structural shielding.** All provisions of part 4730.1600 shall apply except that only secondary barriers shall be required.

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Subp. 3. **Operating conditions.** Operating conditions:

A. The exposure rate measured at the panel or tabletop shall be as low as practicable but shall not exceed ten roentgens per minute.

B. With the fluorescent screen 14 inches (35 centimeters) from the panel or tabletop, the exposure rate two inches (five centimeters) beyond the viewing surface of the screen shall not exceed 30 milliroentgens per hour for each roentgen per minute at the tabletop with the screen in the useful beam without a patient and with the fluoroscope operating at the highest potential employed.

C. The fluoroscopist shall wear a pair of protective gloves of at least 0.25 millimeter lead equivalent when the hands are used in the primary unattenuated beam or on the patient.

D. Extraneous light that interferes with the fluoroscopic examination shall be eliminated.

E. The fluoroscopist's eyes shall be sufficiently dark-adapted for the visual task required before commencing fluoroscopy. Wearing red goggles for ten minutes will usually satisfy adaptation requirements. Dark adaptation normally is not necessary when image intensifiers are used.

Subp. 4. **Mobile fluoroscopic equipment.** Mobile fluoroscopic equipment shall meet the requirements of part 4730.1700, subparts 1 and 2 where applicable, except that:

A. In the absence of a tabletop, a cone or spacer frame shall limit the target-to-skin distance to not less than 12 inches.

B. Image intensification shall always be provided.

C. It shall be impossible to operate mobile fluorscopic equipment unless the useful beam is intercepted by the image intensifier.

Statutory Authority: *MS s 144.121*

4730.1800 RADIOGRAPHIC INSTALLATIONS OTHER THAN DENTAL, VETERINARY MEDICINE, AND INDUSTRIAL.

Subpart 1. **Equipment.** For radiographic installations other than dental, veterinary medicine, and industrial:

A. The protective tube housing shall be of the diagnostic type.

B. Suitable devices (diaphragms, cones, adjustable collimators) capable of restricting the useful beam to the area of clinical interest shall be provided to define the beam and shall provide the same degree of attenuation as that required of the tube housing. Such devices shall be calibrated in terms of the size of the projected useful beam at all utilized focal spot to film distances.

C. Radiographic equipment, particularly multipurpose machines, should be equipped with adjustable collimators containing light localizers that define the entire field. Rectangular collimators are usually preferable. The field size indication on adjustable collimators shall be accurate to within one inch for a source-film distance of 72 inches. The light field shall be aligned with the X-ray field with the same degree of accuracy. The size of the X-ray beam projected by fixed aperture cones and collimators shall not exceed the dimensions of the X-ray film by more than two inches for a source-film distance (SFD) of 72 inches or one inch for a source-film distance of 36 inches.

D. Ruled scales shall be aligned both on the machine and beside the chest cassette holder to aid in accurately positioning the tube. A light beam indicator or a coupling device may be used in place of ruled scales.

E. The aluminum equivalent of the total filtration in the useful beam shall be not less than that shown in the following table:

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Operating Kilovolts Peak	Minimum Total Filtration (inherent plus added)
Below 50	0.5 millimeter aluminum
50-70	1.5 millimeters aluminum
Above 70	2.5 millimeters aluminum

The above requirements for filtration shall be assumed to have been met if the half-value layer is not less than that shown in the following table:

Operating Voltage (kVp)	Half-Value Layer (millimeters aluminum)
49	0.6
70	1.6
90	2.6
100	2.9
110	3.1
120	3.4

F. A device shall be provided to terminate the exposure after a preset time or exposure.

G. A dead-man type of switch shall be so arranged that it cannot be conveniently operated from a position outside a shielded area. Exposure switches for spot film devices used in conjunction with fluoroscopic tables are exempted from this shielding arrangement.

H. The control panel shall include a device (usually a milliammeter) to give positive indication of the production of X rays whenever the X-ray tube is energized. The control panel shall include devices (labeled control settings and/or meters) indicating the physical factors (such as kilovolts peak, milliamperage, exposure time, or whether timing is automatic) used for the exposure.

Subp. 2. **Structural shielding.** In addition to the requirements of part 4730.1600 the following apply:

A. All wall, floor, and ceiling areas exposed to the useful beam shall have primary barriers. Primary barriers in walls shall extend to a minimum height of 84 inches from the floor.

B. Secondary barriers shall be provided in all wall, floor, and ceiling areas not having primary barriers or where the primary barrier requirements are lower than the secondary barrier requirements.

C. The operator's station at the control shall be behind a protective barrier, either in a separate room, in a protected booth, or behind a shield which will intercept the useful beam and any radiation which has been scattered only once.

D. A lead glass window with a lead-equivalence equal to that of the adjacent barrier or a mirror system shall be provided large enough and so placed that the operator can see the patient without having to leave the protected area during exposure.

E. Radiographic X-ray units powered equivalent to dental units shall meet the same shielding requirements as parts 4730.2100, subpart 2 and 4730.2400, subpart 2.

Subp. 3. **Operating procedures.** Operating procedures:

A. No individual occupationally exposed to radiation shall be permitted to hold patients during exposures except during emergencies, nor shall any individual be used regularly for this service. Anyone holding a patient during X-ray exposures shall wear a protective apron and protective gloves of at least 0.25 millimeter of lead equivalence. He shall be so positioned that no part of his body will be struck by the useful beam.

B. Only individuals required for the radiographic procedure shall be in the radiographic room during exposures. Except for the patient, no parts of their bodies shall be in the useful beam. The useful beam shall be restricted to the area of clinical interest.

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C. Adults of reproductive age and children should be provided with gonadal protection of at least 0.25 millimeter of lead equivalent when appropriate.

Statutory Authority: *MS s 144.121*

4730.1900 SPECIAL REQUIREMENTS FOR MOBILE DIAGNOSTIC RADIOGRAPHIC EQUIPMENT OTHER THAN DENTAL, VETERINARY MEDICINE, AND INDUSTRIAL.

Subpart 1. **Equipment.** Equipment:

A. All requirements of part 4730.1800, subpart 1 apply except part 4730.1800, subpart 1, items C and F.

B. The exposure control switch shall be of the dead-man type and shall be so arranged that the operator can stand at least six feet from the patient and well away from the useful beam.

C. A light beam indicator shall be used to aid in accurately positioning the tube.

Subp. 2. **Structural shielding.** When a mobile unit is used routinely in one location, it shall be considered a fixed installation subject to the shielding requirements specified in parts 4730.1600 and 4730.1800, subpart 2.

Subp. 3. **Operating procedures.** Operating procedures:

A. All provisions of part 4730.1800, subpart 3 apply except part 4730.1800, subpart 3, item B.

B. Inherent provision shall be made so that the equipment is not operated at source-skin distances of less than 12 inches.

C. Personnel monitoring shall be required for all individuals operating mobile X-ray equipment.

D. Protective lead aprons of at least 0.25 millimeter of lead equivalence shall be worn by operators of mobile radiographic equipment.

Statutory Authority: *MS s 144.121*

4730.2000 SPECIAL REQUIREMENTS FOR CHEST PHOTOFLUOROGRAPHIC INSTALLATIONS.

Subpart 1. **Equipment.** All provisions of part 4730.1800, subpart 1 apply except that a collimator shall restrict the useful beam to the area of the photofluorographic screen and a movable tube housing shall be coupled to the screen.

Subp. 2. **Structural shielding.** All provisions of parts 4730.1600 and 4730.1800, subpart 2 apply.

Subp. 3. **Operating procedures.** Operating procedures:

A. All provisions of part 4730.1800, subpart 3 apply.

B. All individuals except the patient being examined shall be in shielded positions during exposures.

C. Personnel monitoring shall be required for all individuals operating the equipment and for clerical assistants in the controlled area.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.2100 DENTAL RADIOGRAPHIC INSTALLATIONS.

Subpart 1. **Equipment.** For dental radiographic installations:

A. The tube housing shall be of diagnostic type.

B. Diaphragms or cones shall be used for collimating the useful beam and shall provide the same degree of protection as the housing. The diameter of the useful beam at the cone tip shall not be more than 2-3/4 inches for intra-oral radiography. With rectangular collimation, the longer side of the rectangle shall not exceed two inches.

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C. Only open-end shielded cones shall be used after January 1, 1975.

D. A cone or spacer frame shall provide a target-to-skin distance of not less than seven inches with apparatus operating above 50 kilovolts peak or four inches with apparatus operating at 50 kilovolts peak or below.

E. The aluminum equivalent of the total filtration in the useful beam shall be not less than that shown in the following table:

Operating Kilovolts Peak	Minimum Total Filtration (inherent plus added)
At or Below 70	1.5 millimeters aluminum
Above 70	2.5 millimeters aluminum

The above requirements for filtration shall be assumed to have been met if the half-value layer is not less than that shown in the following table:

Operating Voltage (kVp)	Half-Value Layer (millimeters aluminum)
At or Below 70	1.5
Above 70	2.5

F. A device shall be provided to terminate the exposure after a preset time or exposure.

G. The exposure control switch shall be of the dead-man type.

H. Each installation shall be provided with a protective barrier for the operator or shall be so arranged that the operator can stand at least six feet from the patient and well away from the useful beam.

I. Mechanical support of the tube head and pointer cone shall maintain the exposure position without drift or vibration.

J. The X-ray control panel shall include means for indication of: tube voltage, tube current (mA), and exposure duration.

The control panel should be so placed that the magnitude of these factors can be observed during the exposure procedure. The tube voltage and milliamperage shall be indicated by meters or by control settings. A milliammeter, a light or other device shall give visual indication when X rays are being produced.

Subp. 2. **Structural shielding.** In addition to the requirements of part 4730.2400, subpart 2:

A. Dental rooms containing X-ray machines shall be provided with primary barriers at all areas struck by the useful beam. In many cases structural materials of ordinary walls suffice as a protective barrier without addition of special shielding material.

B. When dental X-ray units are installed in adjacent rooms or areas, protective barriers shall be provided between the rooms or areas.

Subp. 3. **Operating procedures.** Operating procedures:

A. The exposure at the tip of the pointer cone shall be as low as practicable and shall not exceed 0.8 roentgen per film for intra-oral radiography.

B. Neither the dentist nor his assistant shall be permitted to hold patients or films during X-ray exposures, nor shall any individual be regularly used for this purpose.

C. During each X-ray exposure the operator shall stand at least six feet from the patient or behind a protective barrier.

D. Only the patient shall be in the useful beam.

E. Neither the tube housing nor the pointer cone shall be hand held during X-ray exposures by anyone.

F. Fluoroscopy shall not be used in dental examinations.

G. Adults of reproductive age and children shall be provided with

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gonadal protection when a full mouth series of exposures are made with intra-oral radiography.

Subp. 4. **Panoramic installations.** This subpart applies to those installations which consist of a tube head with a collimator providing a narrow (1-2 mm) useful beam and an extra-oral film carrier which are interlocked in their motion about the patient. Such equipment shall meet the requirements of subpart 1, items A, B, E, G, and J. While the narrow useful beam and the shielding of the film carrier reduce the need for structural shielding and operator protection, the guidance of a qualified expert should be sought whenever high workloads are anticipated; for example, in X-ray surveys of large numbers of persons in succession.

Statutory Authority: *MS s 144.121*

4730.2200 THERAPEUTIC X-RAY INSTALLATIONS.

Subpart 1. **Equipment.** Equipment:

A. The protective tube housing shall be of the therapeutic type.

B. Permanent diaphragms or cones used for collimating the useful beam shall afford the same degree of protection as the tube housing. Adjustable or removable beam-defining diaphragms or cones shall transmit not more than five percent of the useful beam obtained at the maximum kilovoltage and with maximum treatment filter.

C. Filters shall be secured in place to prevent them from dropping out during treatment. The filter slot shall be so constructed that the radiation escaping through it does not exceed one roentgen per hour at one meter, or, if the radiation from the slot is accessible to the patient, 30 roentgens per hour at five centimeters from the external opening.

D. A filter identification system shall be used on all therapy machines with changeable filters. The filter(s) shall be clearly visible for easy recognition by the operator from his position at the controls or the presence or absence of any filter shall be indicated at the control panel designed to permit easy recognition of the specific filter in place.

E. The X-ray tube shall be so mounted that it cannot turn or slide with respect to the aperture.

F. Means shall be provided to immobilize the tube housing during stationary portal treatment.

G. A suitable exposure control device (e.g., an automatic timer, exposure meter or dose meter) shall be provided to terminate the exposure after a preset time interval or preset exposure or dose limit. Means shall also be provided for the operator to terminate the exposure at any time.

H. Equipment utilizing shutters to control the useful beam shall have a shutter position indicator on the control.

I. There shall be on the control panel an easily discernible indicator which will give positive information as to whether or not the X-ray tube is energized.

J. Operating units shall not be left unattended at any time.

Subp. 2. **Structural shielding.** In addition to the requirements of part 4730.1600:

A. All wall, floor, and ceiling areas that can be struck by the useful beam, plus a border of one foot, shall be provided with primary protective barriers based on use factors involved.

B. All wall, floor, and ceiling areas that, because of restrictions in the orientation of the useful beam, will not be struck by the useful beam shall be provided with secondary barriers.

C. With equipment operating above 125 kilovolts peak, the required barriers shall be an integral part of the building.

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D. With equipment operating above 150 kilovolts peak, the control station shall be within a protective booth or outside the treatment room.

E. Interlocks shall be provided for X-ray therapy equipment capable of operating above 150 kilovolts peak so that when any door of the treatment room is opened, either the machine will shut off automatically or the radiation level within the room will be reduced to an average of not more than two milliroentgens per hour and a maximum of ten milliroentgens per hour at a distance of one meter in any direction from the target. After shutoff or reduction in exposure rate, restoration of the machine to full operation shall be possible only from the control panel.

F. Provision shall be made to permit continuous observation of patients during irradiation.

G. Windows, mirror systems, or closed-circuit television viewing screens used for observing the patient shall be so located that the operator may see the patient and the control panel from the same position.

H. Means for aural communication between the patient and control room shall be provided (e.g., voice, buzzer).

Subp. 3. **Operating procedures.** Operating procedures:

A. All new installations, and existing installations not previously surveyed, shall have a protection survey conducted by, or under the direction of, a person who by training and experience is qualified to evaluate such installation. A protection survey shall also be conducted following any change in the installation which might produce a radiation hazard. The surveyor shall report his findings in writing to the person in charge of the installation, a copy of which shall be made available to the commissioner of health.

B. The installation shall be operated in compliance with any limitations indicated by the protection survey.

C. If any individual is required to be in the treatment room with the patient during exposure because of clinical necessity, he shall be protected as much as possible from scattered radiation and shall not be in the useful beam. The individual so required shall not be one who is occupationally exposed to radiation and no individual shall be used regularly for this service. The exposure of any individual used for this purpose shall be monitored.

D. The output of each therapeutic X-ray machine shall be calibrated by, or under the direction of, a person who by training and experience is qualified to evaluate such installations. The calibration shall be repeated after any change in or replacement of components of the X-ray generating equipment which could cause a change in X-ray output. Check calibration shall be made at least once a year thereafter. Records of calibration shall be maintained by the registrant.

Statutory Authority: *MS s 144.121*

History: *L 1977 c 305 s 39*

4730.2300 SPECIAL REQUIREMENTS FOR X-RAY THERAPY EQUIPMENT OPERATED AT POTENTIALS OF 60 KILOVOLTS AND BELOW.

Subpart 1. **Equipment.** All provisions of part 4730.2200, subpart 1 apply with the following exception: Such X-ray therapy units which are used for contact therapy shall meet the additional requirement that the leakage radiation measured at two inches (five centimeters) from the housing shall not exceed 0.1 roentgen per hour.

Subp. 2. **Structural shielding.** All requirements of part 4730.1600 shall apply.

Subp. 3. **Operating procedures.** Operating procedures:

A. Automatic timers shall be provided which will permit accurate presetting and determination of exposure as short as one second.

B. In the therapeutic application of apparatus constructed with berylli-

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um or other low-filtration windows, the registrant shall ensure that the unfiltered radiation reaches only the part intended and that the useful beam is blocked at all times except when actually being used.

C. If the tube is hand-held during irradiation, the operator shall wear protective gloves of at least 0.25 millimeter lead equivalence.

Statutory Authority: *MS s 144.121*

4730.2400 VETERINARY MEDICINE RADIOGRAPHIC INSTALLATIONS.

Subpart 1. **Equipment.** Equipment:

A. The protective tube housing shall be of the diagnostic type.

B. Diaphragms or cones shall be provided for collimating the useful beam to the area of clinical interest and shall provide the same degree of protection as is required of the housing.

C. Except when contraindicated for a particular radiographic purpose, the total filtration permanently in the useful beam shall not be less than 1.5 millimeters aluminum equivalent for equipment operating at or below 70 kilovolts peak and 2.0 millimeters aluminum equivalent for machines operated in excess of 70 kilovolts peak.

D. A device shall be provided to terminate the exposure after a preset time or exposure.

E. A dead-man type of exposure switch shall be provided together with an electrical cord of sufficient length so that the operator can stand out of the useful beam and at least six feet from the animal or behind a protective barrier during all X-ray exposures.

Subp. 2. **Structural shielding.** All wall, ceiling, and floor areas shall be equivalent to, or provided with, appropriate protective barriers as required in part 4730.1800, subpart 2.

Subp. 3. **Operating procedures.** Operating procedures:

A. The operator shall stand well away from the tube housing and the animal during radiographic exposures. Provisions shall be made so that the operator will not be required to stand in the useful beam. Hand held fluoroscopic screens shall not be used. The tube housing shall not be held by the operator. No individual other than the operator shall be in the X-ray room while exposures are being made unless such individual's assistance is required or he is a student receiving instruction and the recommended protective procedures are followed.

B. In any procedure in which the operator or other assisting individual is not located behind a protective barrier, clothing consisting of a protective apron having a lead equivalent of not less than 0.25 millimeter shall be worn by the operator and any other individuals in the room during X-ray exposures.

C. No individual shall be regularly employed to hold or support animals or hold film during radiation exposures. Occupationally exposed individuals shall not perform the service except in cases in which no other method is available. Any individual holding or supporting an animal during radiation exposure shall wear protective gloves and apron having a lead equivalence of not less than 0.25 millimeter. No individual assisting as the film cassette holder shall have any portion of his body in the useful beam, including the hand inside the protective glove.

Statutory Authority: *MS s 144.121*

4730.2500 INDUSTRIAL X-RAY INSTALLATIONS.

Subpart 1. **Classes.** Industrial X-ray installations shall be classified as either Class A, Class B, Class C, Class D, or Special Class as specified by the registrant at the time of registration.

Class A permits unlimited use of maximum capacity.

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Class B permits unlimited use under limited operating conditions.

Class C permits limited use under specified conditions.

Class D permits limited use and temporary operation and includes portable or mobile industrial X-ray installations.

Special Class covers those installations which use X-ray devices for thickness measurements or coating weight determinations on continuously moving webs.

Subp. 2. **Class A installation requirements.** In Class A installations:

A. The X-ray source and the objects exposed to X-rays must be contained within a permanent enclosure except as provided in item E. The enclosure construction shall attenuate the primary and secondary radiation so that the exposure rate at any accessible external point shall not exceed two milliroentgens per hour when:

(1) the X-ray beam is adjusted to give maximum exposure rate with the X-ray generator at maximum;

(2) the X-ray tube is placed in the shortest tube-to-wall radiographically useable position.

B. Reliable interlocks shall be provided which will prevent entering of the enclosure while the X-ray generator is in operation or will terminate the generation of X rays should the enclosure be opened.

C. Persons shall at all times be able to escape from the enclosure.

D. The enclosure shall be equipped with visible and/or audible signals. Such signals shall be activated upon generation of X rays and shall remain activated continually while X rays are being generated.

E. If the ceiling barrier does not attenuate the exposure rate as set forth in item A, a posted barrier such as a fence shall be used to restrict access to the ceiling area.

F. No person shall be permitted to remain within the enclosure while the X-ray generator is in operation.

G. No X-ray apparatus or other radiographic unit shall be left unattended without either the apparatus being locked in an inoperable condition or the room or building in which the apparatus is located being locked in a manner which will prevent its use by unauthorized personnel.

H. All protective enclosures and equipment shall be kept in good condition.

Subp. 3. **Class A operating and emergency procedures.** In Class A installations:

A. A written manual of operating and emergency procedures shall be in the possession of the operator and the person responsible for each installation. The operating procedures shall be so designed that every practicable means have been employed to minimize exposure and that no person is likely to be exposed to radiation doses that exceed the maximum permissible doses specified in part 4730.3300.

B. The commissioner of health shall be notified in the event of an accident resulting in a possible or actual exposure of a person in excess of the design basis specified in item A.

C. A radiation protection survey shall be performed when changes have been made in shielding, operation, or equipment. The installation shall be checked periodically for unknown changes and malfunctioning equipment.

D. Records shall be maintained of each radiation protection survey and such records shall be available to the commissioner of health or its authorized agents.

E. Utilization logs showing the voltage, current, and exposure time for each radiographic exposure shall be maintained.

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Subp. 4. **Class B installation requirements and operating and emergency procedures.** Requirements and procedures:

A. All requirements of subparts 2 and 3 apply.

B. The controls for the kilovoltage and milliamperage shall be limited by mechanical or electrical means so that the maximum normal operating conditions specified by the registrant at the time of registration cannot be exceeded.

Subp. 5. **Class C installation requirements and operating and emergency procedures.** All requirements of subparts 2 and 3 apply except that:

A. An exposure rate of 50 milliroentgens per hour at accessible external points is allowable.

B. The workload of the machine shall be restricted so that the cumulative exposure at any accessible point outside the protective enclosure does not exceed 100 milliroentgens in any seven consecutive days.

C. The number of hours per day or week for permissible operation shall be stated on the registration form.

D. Warning signs shall be posted in those areas outside the protection barriers in which the exposure rate at any accessible external point exceeds two milliroentgens per hour with the generator operating at its maximum capacity. A visible and/or audible signal shall be provided within the posted area which shall be activated during the generation of X rays.

E. Continuous personnel monitoring shall be enforced for all personnel in the posted area at all times.

Subp. 6. **Class D installation requirements and operating and emergency procedures.** An X-ray installation not meeting the requirements for class A, class B, or class C installation may be operated for a period of 30 days provided the requirements listed below are met. When the 30-day period is impractical or when an undue and unnecessary hardship is involved, the period may be extended by the commissioner of health.

A. All provisions of subpart 3 apply.

B. No X-ray apparatus shall be left unattended without either the apparatus being locked in inoperable condition or the room or building in which the apparatus is located being locked in a manner which will prevent its use by unauthorized personnel.

C. All areas in which the exposure rates exceed five milliroentgens per hour shall be posted and barricaded by a fence, rope, or other suitable personnel barriers erected outside the five milliroentgens per hour iso line.

D. Continuous personnel monitoring shall be enforced for individuals in the posted areas and such other persons who may be specified by the commissioner of health.

E. A calibrated and operable survey instrument shall be available at each installation. The instrument shall have a range such that two milliroentgens per hour through one roentgen per hour can be measured.

F. The initial registration shall be in the possession of the commissioner of health three days before the unit is operated at any location.

G. If the unit has been previously registered and is moved to a new address, the commissioner of health shall be in possession of the notification of a change in work address prior to use of the source at any address other than that indicated on the registration form.

Subp. 7. **Special class — X-ray thickness gauge installation requirements.** Requirements:

A. The X-ray source and the materials exposed to X rays must be contained within a permanent enclosure. The enclosure construction shall attenuate the primary and secondary radiation so that the exposure rate through any portion of the shielding is less than 0.5 milliroentgen per hour and the exposure

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rate through openings in the shielding is less than five milliroentgens per hour at any accessible external point when the equipment is being operated at its maximum potential.

B. Reliable interlocks shall be provided on access doors in the primary and secondary shielding which will terminate the generation of X rays or attenuate the radiation exposure rate to five milliroentgens per hour should the enclosure be opened.

C. The enclosure shall be equipped with visible signals. Such signals shall be activated upon generation of X rays and shall remain activated continually while X rays are being generated. If the X-ray source has a shutter, the enclosure shall also be equipped with a visible signal indicating whether the shutter is open or closed.

Subp. 8. **Special class operating and emergency procedures.** All requirements of subpart 3 apply except item E.

Statutory Authority: *MS s 144.121*

History: *L 1977 c 305 s 39*

RADIUM USES

4730.2600 HEALING ARTS.

Subpart 1. **Requirements.** The following special provisions of this part apply to all registrants who use radium in the healing arts and are in addition to, and not in substitution for, other applicable provisions of the parts 4730.0100 to 4730.3600.

Subp. 2. **Source custodian requirements.** Source custodian:

A. Every hospital, clinic, or physician's office in which a person owns or rents radium sources shall designate a source custodian.

B. The source custodian shall have the necessary training, experience, and inherent or delegated authority to exercise adequate control over the use and accountability of sources.

C. The name of the source custodian shall be submitted to the commissioner of health.

Subp. 3. **Accountability.** The source custodian shall provide accountability of radium sources and shall keep a permanent record of the issue and return of all radium sources.

Subp. 4. **Storage.** When not in use radium sources and applicators containing radium sources shall be kept in a protective enclosure of such material and wall thickness as is necessary to assure that the appropriate limits of radiation will not be exceeded.

Subp. 5. **Local transportation.** For local transportation the container shall have sufficient shielding to assure that the appropriate limits of radiation are not exceeded.

Subp. 6. **Transportation off the premises.** Transportation of radium off the premises shall be in accordance with Code of Federal Regulations, title 49, parts 71 to 78, or Code of Federal Regulations, title 14, part 103, chapter 1, or with post office department regulations, whichever is applicable.

Subp. 7. **Use.** The registrant shall demonstrate to the commissioner of health upon request that the proposed methods of use are consistent with the policy of minimization and are not likely to cause any individuals other than the patient receiving therapy to receive a dose in excess of the maximum permissible dose equivalents.

Subp. 8. **Procedure.** The registrant shall ensure that:

A. During each radiotherapeutic operation unauthorized entry into a radiation area shall be prevented.

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B. The patient's room shall be identified as a radiation area and all individuals entering the room shall comply with the requirements of part 4730.0300, subpart 4.

C. The preparation and dismantling of radium applicators or similar procedures shall be performed behind adequate protective shields. Protective windows or mirror shall be provided for viewing purposes.

D. Remote handling equipment such as tongs and forceps shall be used for all radium sources. Under no circumstances shall a source be touched by the fingers.

E. Loss of radium sources shall be reported to the commissioner of health in accordance with part 4730.1100.

Subp. 9. **Testing radium sources for leakage and contamination.** Testing:

A. The registrant shall provide for testing for leakage and contamination prior to initial use.

B. All radium sources shall be tested for leakage every six months.

C. If there is reason to suspect that a sealed source has been damaged, it shall be tested for leakage before further use.

D. Leak tests shall be capable of detecting the presence of 0.005 microcurie of contamination on the radium source.

E. Leakage of radium sources shall be reported within 24 hours of discovery to the commissioner of health.

F. Any test conducted pursuant to these rules which indicates the presence of 0.005 microcurie or more of contamination shall be considered evidence that the radium source is leaking and the registrant shall immediately withdraw the source from use.

G. All leaking sources shall be decontaminated and reencapsulated or disposed of in accordance with part 4730.2800.

Statutory Authority: *MS s 144.121*

History: *L 1977 c 305 s 39*

4730.2700 INDUSTRIAL RADIUM INSTALLATION.

Subpart 1. **Requirements.** Subparts 2 to 4 establish radiation safety requirements for sealed radium sources utilized for industrial radiography. Nothing in this part shall apply to uses of radium sources in the healing arts.

Subp. 2. **Accountability.** The registrant shall provide accountability of sealed sources and shall keep a permanent record of the issue and return of all sealed sources.

Subp. 3. **Shielding and housing.** The registrant shall assure adequate shielding and housing of the source:

A. When not in use, sealed sources shall be kept in a protective enclosure of such material and wall thickness as is necessary to limit doses to those permitted under these rules.

B. Source housing shall provide the following:

(1) If the source is permanently mounted in a housing with a beam control device or extended from and retracted into a housing, this device shall be of positive design capable of acting regardless of the position of the housing.

(2) It shall be possible to move the source to a shielded position manually with a minimum risk of exposure in the event of the failure of the automatic mechanism.

(3) Warning devices on the housing and the control panel shall plainly indicate whether the apparatus is on or off.

C. Transfer of the source shall be performed according to the following: If the apparatus is of a type in which the source is removed from the shield when

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in use, transfer shall be accomplished by a remote control mechanism. Transfer mechanisms shall be designed to minimize the possibility of damage to the source in transit.

D. Each radiographic exposure device shall be provided with a lock within the enclosure. The enclosure shall also be provided with a lock and shall be kept locked at all times except when under the direct surveillance of the industrial radiographer or his assistant.

Subp. 4. **Leak tests.** Sources shall have leak tests performed as follows:

A. The registrant shall provide for testing for leakage and contamination prior to initial use.

B. All sealed radium sources shall be tested for leakage at least every six months.

C. If there is reason to suspect that a sealed source has been damaged, it shall be tested for leakage before further use.

D. Leak tests shall be capable of detecting the presence of 0.005 microcurie of contamination of radium and its decay products.

E. Any tests conducted which reveal the presence of 0.005 microcurie or more of removable contamination shall be considered evidence that the sealed source is leaking and the registrant shall withdraw the source from use and shall cause it to be decontaminated and resealed or to be disposed of in accordance with part 4730.2800.

F. Leaking or lost sources shall be reported to the commissioner of health in accordance with part 4730.1100.

Subp. 5. **Radiation survey.** A radiation survey shall be made after each use to determine that the radium source has been returned to its shielded position. Records shall be kept of each survey for inspection by the commissioner of health.

Statutory Authority: *MS s 144.121*

History: *L 1977 c 305 s 39*

4730.2800 WASTE DISPOSAL OF RADIUM SOURCES.

Radium sources considered to be waste shall be disposed of through one of the following:

A. a radium collection agency;

B. a private radium collection company;

C. an institution that has suitable waste disposal facilities.

The delivery of radium waste to the receiver shall be in accordance with part 4730.1000.

Statutory Authority: *MS s 144.121*

4730.2900 SPECIAL USES OF ELECTRIC EQUIPMENT.

Subpart 1. **Accelerators, X-ray diffraction units, and electron microscopes.** Accelerators, X-ray diffraction units, and electron microscopes shall be installed, shielded, and operated in such a manner that no one shall be exposed beyond the appropriate limits as defined in part 4730.0300, subpart 4.

Subp. 2. **Television receivers.** No television receivers shall be manufactured, sold, demonstrated, or otherwise distributed unless they are in conformity with the Code of Federal Regulations, title 42, part 78.

Subp. 3. **Research and teaching institutions.** The following special provisions of this part apply to all registrants who use ionizing radiation in research and teaching institutions and are in addition to, and not in substitution for, other applicable provisions of these rules:

A. The possession by secondary or elementary schools of radium-226 in excess of those quantities exempted in part 4730.3500 shall be prohibited.

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B. The use of registerable sources of ionizing radiation in secondary or elementary schools is limited to registrants specifically designated by the commissioner of health or licensed by the U.S. Atomic Energy Commission to use by-product materials. The commissioner of health may authorize a registrant to use sources of ionizing radiation if the registrant demonstrates sufficient knowledge of radiation protection and if applicable principles of radiation protection have been implemented in the physical construction and/or preparation of the source.

C. Students under 18 years of age shall not receive in any period of one calendar quarter a whole body exposure exceeding ten percent of the limits specified in part 4730.3300.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.3000 NUCLEAR FACILITIES.

Subpart 1. **Nuclear reactor.** The term "nuclear reactor" as used herein means any installation, machine, device, or assemblage or collection of installations, machines, or devices that does or is intended or designed to contain a controlled self-sustaining neutron chain reaction. The term "facility" as used herein includes nuclear reactors and also includes any plant, installation, or device for processing or reprocessing nuclear fuel, and any plant, installation, device, place, or location for disposal of radioactive wastes or for temporary or permanent disposal of radioactive materials, equipment, or nuclear fuel.

Subp. 2. **Facility.** Before the construction of any nuclear reactor or facility is started within this state a general description thereof shall be submitted to the commissioner of health containing such information as may be necessary or appropriate to a determination of any actual or potential hazard to or effect upon the public health, and specifying the following information:

A. the name, address, and corporate or individual character of the person who will own the facility, and, if different, of the person who will operate it;

B. the name and address of the principal contractors who will construct the facility;

C. a description of the general character of the means employed to utilize nuclear energy;

D. a statement as to the character, quantity, and source of the materials that will be utilized as a source of nuclear energy;

E. a description of the precise location of the facility with reference to any relevant known topographical, subsurface, or meteorological features of the location, such as adjacent bodies of water;

F. a statement as to plans for monitoring levels of radioactivity in the various phases of the environment;

G. a statement as to the anticipated quantity and means of storage and disposition of any radioactive waste materials that will result from the operation;

H. a preliminary statement as to the standards and measures that will be employed to ensure the safety of personnel employed in or near the proposed facility;

I. a preliminary statement as to the standards and measures that will be employed to prevent radioactive contamination of air, water, and other elements of the environment;

J. a preliminary statement specifying in standard scientific terms and quantitative units the nature and amount of radioactivity that will be permitted to pass into the environmental air, water, and other elements within a specified period of time, stating in what manner and form such radioactivity will be

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permitted to pass into the environment and describing the safety checks that will be employed to ensure that no larger quantity of radioactivity escapes into the environment; and

K. a preliminary description of the maximum credible accident which might occur at the proposed facility and how it will be controlled, together with any information relevant to a complete hazard report.

Subp. 3. **Approval by commissioner of health.** No part of the construction of a nuclear reactor or facility shall be started within this state without the express approval of the commissioner of health until 30 days after the submission to it of such description and information. Within 30 days after such submission the commissioner of health, or the duly authorized agents, may require the submission of additional information relating to any specific matter referred to herein, and the commissioner of health or the duly authorized agents, may object to any part of the proposed design, description, plans, method of operation, standards, or safety measures, upon the grounds that the public health is endangered, and may require such modification in such design, plans, method of operation, standards, or safety measures as will eliminate the danger to the public health. In the event that within 30 days after the submission to it of the description, information, design, and plans for a proposed nuclear reactor or facility the commissioner of health does not object to any part thereof, the facility may be constructed in accordance with the description, design, and plans submitted to the commissioner of health.

Subp. 4. **Changes in plans.** If there is any substantial deviation from or change in the description, design, or plans as submitted to the commissioner of health, full information relating to such deviation or change shall be submitted to the commissioner of health immediately.

Subp. 5. **Opening of plant.** The commissioner of health shall be notified of the date when it is proposed that a nuclear reactor shall be put into operation. Such notification shall specify any deviations from, or changes in, the description, design, or plans as previously submitted to the commissioner of health and the facility as actually constructed. At least 30 days, and not more than 60 days, prior to this proposed date, the owner of the reactor shall apply to the commissioner of health for approval to operate the facility. No reactor shall be operated in this state until the owner has received, and is in the possession of, such an approval.

Subp. 6. **Changes in facility.** Whenever it is proposed to alter, enlarge, move, or substantially modify or change any existing nuclear reactor or facility, the description, design, and plans of such proposed alteration, enlargement, move, modification, or change shall be submitted to the commissioner of health at least 30 days prior to the time that it is proposed to initiate such work, and these rules shall apply to any substantial alteration or enlargement as though such work were the construction of a new facility.

Subp. 7. **Monitoring of radioactivity.** The operator of each nuclear reactor or facility within this state shall report to the commissioner of health at least annually, stating the measures that have been taken during the preceding year to monitor and measure the nature and amount of radioactivity discharged or allowed to escape into the environment from such facility, and stating in standard scientific terms and quantitative units the nature and quantity of radioactivity that has been discharged or allowed to escape into the environment during the preceding year.

Subp. 8. **Reporting of accidents.** When an accident or other situation occurs in this state in the operation of a nuclear reactor or facility which results or threatens to result in the radioactive contamination of a person, animal, or the environment, or the exposure of a person to, or the escape into the environment of, ionizing radiation in a manner or to a degree or in a quantity different or greater than specified in the description and information last previously filed with

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the commissioner of health, it shall be the duty of the owner and operator and of the person then in charge of such facility to have notification of such occurrence communicated to the commissioner of health by telephone immediately upon the discovery of the facts, and to have all facts and circumstances of the occurrence reported in detail in writing to the commissioner of health within seven days thereafter.

Subp. 9. **Applicability.** Any facility in design or under construction as of January 1, 1959, shall not be exempt from the provisions of these rules.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

History: *L 1977 c 305 s 39*

4730.3300 MAXIMUM PERMISSIBLE DOSES (DOSE EQUIVALENTS).

	Average weekly dose[a]	Maximum 13-week dose	Maximum yearly dose	Maximum accumulated dose[c]
Occupational Personnel	rem[b]	rem[b]	rem[b]	rem[b]
Controlled areas —				
Occupational Dose				
Whole body, gonads, blood-forming organs, and lens of eye	0.1	1 1/4		5(N-18)
Skin of whole body		7 1/2	30	
Hands and forearms, head, neck, feet, and ankles	1.5	18 3/4	75	
Public				
Environs (Noncontrolled areas)				
Nonoccupational Dose	0.01		0.5	

Notes:

N = Age in years and is greater than 18.

[a]For design purposes only.

[b]The dose in rems may be assumed to be equal to the exposure in roentgens for X and gamma rays.

[c]Where an employee's accumulative dose is partly due to radiation from isotopes and partly to radiation from X-ray units, the limits established in part 4730.3300, would apply to the sum of the radiation doses.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.3400 NEUTRON FLUX DOSE EQUIVALENTS.

Neutron Energy (MeV)	Number of Neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm^2)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm^2 per sec.)
Thermal	970×10^6	670
0.0001	720×10^6	500
0.005	820×10^6	570
0.02	400×10^6	280
0.1	120×10^6	80
0.5	43×10^6	30

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1.0	26×10^6	18
2.5	29×10^6	20
5.0	26×10^6	18
7.5	24×10^6	17
10.0	24×10^6	17
10 to 30	14×10^6	10

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.3500 REGISTRATION EXEMPTION POSSESSION LIMITS.

Material	Microcuries
Americium 241	0.01
Antimony 122	100
Antimony 124	10
Antimony 125	10
Arsenic 73	100
Arsenic 74	10
Arsenic 76	10
Arsenic 77	100
Barium 131	10
Barium 140	10
Bismuth 210	1
Bromine 82	10
Cadmium 109	10
Cadmium 115m	10
Cadmium 115	100
Calcium 45	10
Calcium 47	10
Carbon 14	100
Cerium 141	100
Cerium 143	100
Cerium 144	1
Cesium 131	1,000
Cesium 134m	100
Cesium 134	1
Cesium 135	10
Cesium 136	10
Cesium 137	10
Chlorine 36	10
Chlorine 38	10
Chromium 51	1,000
Cobalt 58m	10
Cobalt 58	10
Cobalt 60	1
Copper 64	100
Dysprosium 165	10
Dysprosium 166	100
Erbium 169	100
Erbium 171	100
Europium 152 9.2h	100
Europium 152 13 yr	1
Europium 154	1
Europium 155	10
Fluorine 18	1,000
Gadolinium 153	10
Gadolinium 159	100

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Gallium 72	10
Germanium 71	100
Gold 198	100
Gold 199	100
Hafnium 181	10
Holmium 166	100
Hydrogen 3	1,000
Indium 113m	100
Indium 114m	10
Indium 115m	100
Indium 115	10
Iodine 125	1
Iodine 126	1
Iodine 129	0.1
Iodine 131	1
Iodine 132	10
Iodine 133	1
Iodine 134	10
Iodine 135	10
Iridium 192	10
Iridium 194	100
Iron 55	100
Iron 59	10
Krypton 85	100
Krypton 87	10
Lanthanum 140	10
Lutetium 177	100
Manganese 52	10
Manganese 54	10
Manganese 56	10
Mercury 197m	100
Mercury 197	100
Mercury 203	10
Molybdenum 99	100
Neodymium 147	100
Neodymium 149	100
Nickel 59	100
Nickel 63	10
Nickel 65	100
Niobium 93m	10
Niobium 95	10
Niobium 97	10
Osmium 185	10
Osmium 191m	100
Osmium 191	100
Osmium 193	100
Palladium 103	100
Palladium 109	100
Phosphorus 32	10
Platinum 191	100
Platinum 193m	100
Platinum 193	100
Platinum 197m	100
Platinum 197	100
Plutonium 239	0.01
Polonium 210	0.1
Potassium 42	10

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Praseodymium 142	100
Praseodymium 143	100
Promethium 147	10
Promethium 149	10
Radium 226	10
Rhenium 186	100
Rhenium 188	100
Rhodium 103m	100
Rhodium 105	100
Rubidium 86	10
Rubidium 87	10
Ruthenium 97	100
Ruthenium 103	10
Ruthenium 105	10
Ruthenium 106	1
Samarium 151	10
Samarium 153	100
Scandium 46	10
Scandium 47	100
Scandium 48	10
Selenium 75	10
Silicon 31	100
Silver 105	10
Silver 110m	1
Silver 111	100
Sodium 24	10
Strontium 85	10
Strontium 89	1
Strontium 90	0.1
Strontium 91	10
Strontium 92	10
Sulfur 35	100
Tantalum 182	10
Technetium 96	10
Technetium 97m	100
Technetium 97	100
Technetium 99m	100
Technetium 99	10
Tellurium 125m	10
Tellurium 127m	10
Tellurium 127	100
Tellurium 129m	10
Tellurium 129	100
Tellurium 131m	10
Tellurium 132	10
Terbium 160	10
Thallium 200	100
Thallium 201	100
Thallium 202	100
Thallium 204	10
Thorium (natural)	50
Thulium 170	10
Thulium 171	10
Tin 113	10
Tin 125	10
Tungsten 181	10
Tungsten 185	10

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Tungsten 187	100
Uranium (natural)	50
Uranium 233	0.01
Uranium 234 - Uranium 235	0.01
Vanadium 48	10
Xenon 131m	1,000
Xenon 133	100
Xenon 135	100
Ytterbium 175	100
Yttrium 90	10
Yttrium 91	10
Yttrium 92	100
Yttrium 93	100
Zinc 65	10
Zinc 69m	100
Zinc 69	1,000
Zirconium 93	10
Zirconium 95	10
Zirconium 97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01
Any radionuclide other than alpha emitting radionuclides not listed above or mixtures of beta emitters of unknown composition	0.1

Note: Where there is a combination of isotopes in known amounts the limit for the combination shall be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

Example: If a particular batch contains 20,000 μCi of Au^{198} and 50,000 μCi of C^{14}, it may also include not more than 300 μCi of I^{131}. This limit was determined as follows:

$$\frac{20{,}000\ \mu Ci\ Au^{198}}{100{,}000\ \mu Ci} + \frac{50{,}000\ \mu Ci\ C^{14}}{100{,}000\ \mu Ci} + \frac{300\ \mu Ci\ I^{131}}{1{,}000\ \mu Ci} = 1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000.

Statutory Authority: *MS s 144.12 subd 1; 144.121*

4730.3600 EXEMPT CONCENTRATIONS.

Element (atomic number)	Isotope	Column I Gas concentration μCi/ml[1]	Column II Liquid and solid concentration μCi/ml[2]
Antimony (51)	Sb 122		$3x10^{-4}$

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	Sb 124		$2x10^{-4}$
	Sb 125		$1x10^{-3}$
Argon (18)	A 37	$1x10^{-3}$	
	A 41	$4x10^{-7}$	
Arsenic (33)	As 73		$5x10^{-3}$
	As 74		$5x10^{-4}$
	As 76		$2x10^{-4}$
	As 77		$8x10^{-3}$
Barium (56)	Ba 131		$2x10^{-3}$
	Ba 140		$3x10^{-4}$
Beryllium (4)	Be 7		$2x10^{-2}$
Bismuth (83)	Bi 206		$4x10^{-4}$
Bromine (35)	Br 82	$4x10^{-7}$	$3x10^{-3}$
Cadmium (48)	Cd 109		$2x10^{-3}$
	Cd 115m		$3x10^{-4}$
	Cd 115		$3x10^{-4}$
Calcium (20)	Ca 45		$9x10^{-5}$
	Ca 47		$5x10^{-4}$
Carbon (6)	C 14	$1x10^{-6}$	$8x10^{-3}$
Cerium (58)	Ce 141		$9x10^{-4}$
	Ce 143		$4x10^{-4}$
	Ce 144		$1x10^{-4}$
Cesium (55)	Cs 131		$2x10^{-2}$
	Cs 134m		$6x10^{-2}$
	Cs 134		$9x10^{-5}$
Chlorine (17)	Cl 38	$9x10^{-7}$	$4x10^{-3}$
Chromium (24)	Cr 51		$2x10^{-2}$
Cobalt (27)	Co 57		$5x10^{-3}$
	Co 58		$1x10^{-3}$
	Co 60		$5x10^{-4}$
Copper (29)	Cu 64		$3x10^{-3}$
Dysprosium (66)	Dy 165		$4x10^{-3}$
	Dy 166		$4x10^{-4}$
Erbium (68)	Er 169		$9x10^{-4}$
	Er 171		$1x10^{-3}$
Europium (63)	Eu 152 (T/2=9.2 Hrs.)		$6x10^{-4}$
	Eu 155		$2x10^{-3}$
Fluorine (9)	F 18	$2x10^{-6}$	$8x10^{-3}$
Gadolinium (64)	Gd 153		$2x10^{-3}$
	Gd 159		$8x10^{-4}$
Gallium (31)	Ga 72		$4x10^{-4}$
Germanium (32)	Ge 71		$2x10^{-2}$
Gold (79)	Au 196		$2x10^{-3}$
	Au 198		$5x10^{-4}$
	Au 199		$2x10^{-3}$
Hafnium (72)	Hf 181		$7x10^{-4}$
Hydrogen (1)	H 3	$5x10^{-6}$	$3x10^{-2}$
Indium (49)	In 113m		$1x10^{-2}$
	In 114m		$2x10^{-4}$
Iodine (53)	I 126	$3x10^{-9}$	$2x10^{-5}$
	I 131	$3x10^{-9}$	$2x10^{-5}$
	I 132	$8x10^{-8}$	$6x10^{-4}$
	I 133	$1x10^{-8}$	$7x10^{-5}$
	I 134	$2x10^{-7}$	$1x10^{-3}$
Iridium (77)	Ir 190		$2x10^{-3}$
	Ir 192		$4x10^{-4}$

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	Ir 194		$3x10^{-4}$
Iron (26)	Fe 55		$8x10^{-3}$
	Fe 59		$6x10^{-4}$
Krypton (36)	Kr 85m	$1x10^{-6}$	
	Kr 85	$3x10^{-6}$	
Lanthanum (57)	La 140		$2x10^{-4}$
Lead (82)	Pb 203		$4x10^{-3}$
Lutetium (71)	Lu 177		$1x10^{-3}$
Manganese (25)	Mn 52		$3x10^{-4}$
	Mn 54		$1x10^{-3}$
	Mn 56		$1x10^{-3}$
Mercury (80)	Hg 197m		$2x10^{-3}$
	Hg 187		$3x10^{-3}$
	Hg 203		$2x10^{-4}$
Molybdenum (42)	Mo 99		$2x10^{-3}$
Neodymium (60)	Nd 147		$6x10^{-4}$
	Nd 149		$3x10^{-3}$
Nickel (28)	Ni 65		$1x10^{-3}$
Niobium (Columbium) (41)	Nb 95		$1x10^{-3}$
	Nb 97		$9x10^{-3}$
Osmium (76)	Os 185		$7x10^{-4}$
	Os 191m		$3x10^{-2}$
	Os 191		$2x10^{-3}$
	Os 193		$6x10^{-4}$
Palladium (46)	Pd 103		$3x10^{-3}$
	Pb 109		$9x10^{-4}$
Phosphorus (15)	P 32		$2x10^{-4}$
Platinum (78)	Pt 191		$1x10^{-3}$
	Pt 193m		$1x10^{-2}$
	Pt 197m		$1x10^{-2}$
	Pt 197		$1x10^{-3}$
Potassium (19)	K 42		$3x10^{-3}$
Praseodymium (59)	Pr 142		$3x10^{-4}$
	Pr 143		$5x10^{-4}$
Promethium (61)	Pm 147		$2x10^{-3}$
	Pm 149		$4x10^{-4}$
Rhenium (75)	Re 183		$6x10^{-3}$
	Re 186		$9x10^{-4}$
	Re 188		$6x10^{-4}$
Rhodium (45)	Rh 103m		$1x10^{-1}$
	Rh 105		$1x10^{-3}$
Rubidium (37)	Rb 86		$7x10^{-4}$
Rutenium (44)	Ru 97		$4x10^{-3}$
	Ru 103		$8x10^{-4}$
	Ru 105		$1x10^{-3}$
	Ru 106		$1x10^{-4}$
Samarium (62)	Sm 153		$8x10^{-4}$
Scandium (21)	Sc 46		$4x10^{-4}$
	Sc 47		$9x10^{-4}$
	Sc 48		$3x10^{-4}$
Selenium (34)	Se 75		$3x10^{-3}$
Silicon (14)	Si 31		$9x10^{-3}$
Silver (47)	Ag 105		$1x10^{-3}$
	Ag 110m		$3x10^{-4}$
	Ag 111		$4x10^{-4}$
Sodium (11)	Na 24		$2x10^{-3}$
Strontium (38)	Sr 89		$1x10^{-4}$
	Sr 91		$7x10^{-4}$

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	Sr 92		$7x10^{-4}$
Sulfur (16)	S 35	$9x1^{-8}$	$6x10^{-4}$
Tantalum (73)	Ta 182		$4x10^{-4}$
Technetium (43)	Tc 96m		$1x10^{-1}$
	Tc 96		$1x10^{-3}$
Tellurium (52)	Te 125m		$2x10^{-3}$
	Te 127m		$6x10^{-4}$
	Te 127		$3x10^{-3}$
	Te 129m		$3x10^{-4}$
	Te 131m		$6x10^{-4}$
	Te 132		$3x10^{-4}$
Terbium (65)	Tb 160		$4x10^{-4}$
Thallium (81)	Tl 200		$4x10^{-3}$
	Tl 201		$3x10^{-3}$
	Tl 202		$1x10^{-3}$
	Tl 204		$1x10^{-3}$
Thulium (69)	Tm 170		$5x10^{-4}$
	Tm 171		$5x10^{-3}$
Tin (50)	Sn 113		$9x10^{-4}$
	Sn 125		$2x10^{-4}$
Tungsten (Wolfram) (74)	W 181		$4x10^{-3}$
	W 187		$7x10^{-4}$
Vanadium (23)	V 48		$3x10^{-4}$
Xenon (54)	Xe 131m	$4x10^{-6}$	
	Xe 133	$3x10^{-6}$	
	Xe 135	$1x10^{-6}$	$1x10^{-3}$
Ytterbium (70)	Yb 175		$1x10^{-3}$
Yttrium (39)	Y 90		$2x10^{-4}$
	y 91m		$3x10^{-2}$
	Y91		$3x10^{-4}$
	Y92		$6x10^{-4}$
	Y93		$3x10^{-4}$
Zinc (30)	Zn 65		$1x10^{-3}$
	Zn 69m		$7x10^{-4}$
	Zn 69		$2x10^{-2}$
Zirconium (40)	Zr 95		$6x10^{-4}$
	Zr 97		$2x10^{-4}$
Beta and/or gamma emitting by-product material not listed above with half-life less than three years.		$1x10^{-10}$	$1x10^{-6}$

NOTE a: Exempt concentrations refer to products or materials containing by-product materials in concentrations not in excess of those specified in the table in this part. Such products or materials may be received, possessed, used, transferred, owned, or acquired without registration.

NOTE b: Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in the table in this part, the activity stated is that of the parent isotope and takes into account the daughters.

NOTE c: Where a combination of isotopes is involved, the limit for the combination should be derived as follows:

Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in the table in this part for the specific isotope when not in combination. The sum of such ratio may not exceed "1" (i.e., unity)

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Example:

$$\frac{\text{Concentration of Isotope A in Product}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} \leq 1$$

[1]Microcuries/milliliter. Values are given only for those materials normally used as gases.

[2]Microcuries/milliliter. Solids measured in microcuries/gram.

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Statutory Authority: *MS s 144.12 subd 1; 144.121*

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