Radiation Control Unit
625 North Robert Street
P.O. Box 64975
St. Paul, MN 55164-0975
651-201-4545
www.health.state.mn.us/xray

Radiation Shielding Plan Review

Please complete and submit the form with your shielding plans and specifications according to the guidelines listed below. Radiation shielding plans should be reviewed by the Minnesota Department of Health (MDH) before construction and before operation of the x-ray equipment.

A. Location of Proposed X-ray Room(s)		☐ Send results of the review to this address	
Facility Name:		Facility Registration Number (if already registered):	
Address:		Unit / Suite Number	
City:	State:	Zip Code:	E-Mail:
Expected Date of Project Completion:			
Telephone Number:	Fax Number:		Cell Number:

B. Previous Location of X-ray Room(s) ***(if applicable)***		☐ Send results of the review to this address	
Facility Name:		Facility Registration Number (if already registered):	
Address:		Unit / Suite Number	
City:	State:	Zip Code:	E-Mail:

C. Submitter of Plan ***(if different than indicated in Part A):***		☐ Send results of the review to this address	
Company Name:		Individual's Name:	
Address:		Unit / Suite Number	
City:	State:	Zip Code:	E-Mail:
Telephone Number:	Fax Number:		Cell Number:

Submit radiation shielding plans and specifications to:	For use by Radiation Control
Radiation Control Minnesota Department of Health 625 Robert Street North PO Box 64975 St. Paul, Minnesota 55164-0975	

Radiation Shielding Plan Review Worksheets

Purpose of Application for Review

- ☐ New X-Ray Room (New Construction)
- ☐ New Equipment in Existing X-Ray Room
- ☐ Remodeling of Existing X-Ray Facility

Type of Facility

- ☐ Hospital
- ☐ Podiatric
- ☐ Educational
- ☐ Radiology Office
- ☐ Veterinary
- ☐ M.D / D.O
- ☐ Dental
- ☐ Chiropractic
- ☐ Industrial
- ☐ Other: _____

Types of Machine

- ☐ Radiographic
- ☐ Dental Cephalometric
- ☐ Extremity Only
- ☐ Fluoroscopic
- ☐ Heart Catheterization
- ☐ Special Procedures
- ☐ CT Scanner
- ☐ Educational
- ☐ Dental CT
- ☐ Dental Panoramic
- ☐ Dental Tomographic
- ☐ Radiographic/fluoroscopic
- ☐ Other: _____

Attach Drawing of the Room(s)

Provide <u>to scale</u> plans or blueprints of the room(s) and adjacent areas. Scale must be ¼ inch per foot or larger. Please verify that all of these items are included in your submittal. Incomplete submittals will delay the plan review.

- ☐ All x-ray equipment and accessories
- ☐ Windows
- ☐ Patient viewing window
- ☐ Wall cassette holder
- ☐ X-ray table (including extent of movement)
- ☐ The exact location of all proposed shielding
- ☐ The thickness of the proposed shielding
- ☐ Doors
- ☐ Operator's barrier
- ☐ Exposure switch (exact location)
- ☐ X-ray tube and extent of movement
- ☐ The height of the shielding installed
- ☐ Compass direction
- ☐ Information about the height of adjacent buildings
- ☐ Building material thicknesses if used for shielding (include architectural documentation)

- ☐ Specify proposed shielding, such as lead (note thickness), brick veneer, solid or hollow-core concrete block, cinder block, poured concrete, etc. Indicate the thickness of concrete and masonry materials. For corrugated concrete floors and ceilings that are used as shielding, include the minimum concrete thickness.
- ☐ Include a description of the occupancy and control of adjoining areas including above and below the x-ray room(s) on the plans.
- ☐ Include a description of any area beyond the outside wall, such as lawn, parking lot, and sidewalk. For exterior walls, show the distance to property line and closest area where individuals may be present.
- ☐ Include the distance to any multi-story buildings that are nearby.

In addition to a diagram of the x-ray room, the following information should be provided so that the Minnesota Department of Health can review the shielding plan.

Required Information	Registrant's Input
The x-ray tube current The average tube current, which is expressed as mA, can be provided by the equipment manufacturer, vendor, or installer. Frequently, the information includes the average exposure time and is expressed as milliampere-seconds (mAs) or milliampere-minutes (mA min). **Enter the x-ray tube current.**	
The average exposure time in seconds Enter the average exposure time. Note: If the x-ray tube current is already in mAs or mA min, skip this part.	
The weekly workload of the x-ray tube Weekly workload can be determined by counting the number of exposures over a period of time and estimating an average number per week. Allow for an increase in patient load. **Enter the projected weekly workload.**	
The maximum kilovolt peak (kVp) of the x-ray device The clinical kVp should be used if the unit is consistently operated below the maximum. (**Enter the maximum clinically used kVp.**	

CT Scanners
In addition, include a copy of the iso-exposure curve, which is normally provided by the manufacturer, and the calculations performed by a medical physicist.

Weekly Workload Calculation

After developing the average number of exposures per week, the weekly workload (W) in minutes can be calculated using the x-ray tube current and the average exposure time as indicated in the following formula:

$$W = \frac{(\text{average number of exposures per week}) \times (\text{average tube current}) \times (\text{exposure time in seconds})}{60}$$

Or

$$W = \frac{(\text{average number of exposures per week}) \times (\text{average tube current in mAs})}{60}$$

Because the weekly workload is a significant factor in determining the shielding requirements, registrants should periodically review the components to ensure that the workload has not significantly increased. A significant increase may require installation of additional shielding.

Use factor (U)
A protective barrier is any structural barrier that is designed to reduce radiation exposure. There is a use factor for the primary protective barrier and a use factor for the secondary protective barriers.

Primary protective barrier
This is the structural barrier designed to reduce the useful beam to the required exposure level. The percent of time (expressed as a fraction) that the x-ray beam is pointed toward a specific barrier (usually the floor and/or a wall) is termed the primary use factor.

☐ Primary Barrier #1

☐ Primary Barrier #2

On the attached sketch, indicate the primary barrier(s) by numbering as Primary Barrier #1 (and Primary Barrier #2, if applicable) on the sketch.

Enter the use factor(s) for the primary barrier(s).	Primary Barrier #1	
	Primary Barrier #2	
Secondary protective barrier This is the structural barrier designed to reduce the stray radiation to the required exposure level. On the attached sketch, indicate the secondary barriers by numbering each secondary wall as Secondary Barrier #1, Secondary Barrier #2, etc. **Enter the use factor for each of the secondary barriers.** Note: The use factor for secondary barriers is usually 1.	Secondary Barrier #1	
	Secondary Barrier #2	
	Secondary Barrier #3	
	Secondary Barrier #4	
	Secondary Barrier #5	

Dimension Information

Primary Barrier **Enter the distance from the source (tube) to the primary barrier(s).**	Primary Barrier #1	
	Primary Barrier #2	
Secondary Barriers **Enter the distance from the source (tube) to the secondary barriers.**		

Occupancy Factors

Referring to the sketch that you provided, identify all adjacent areas adjacent to the x-ray room (e.g., office, file, toilet, closet, and hallway).		
Enter the occupancy factors for each area identified in the step above. Typical Occupancy Factors are indicated below.		

Typical Occupancy Factors (T) (as found in NCRP 147)

T = 1	Work areas such as offices, laboratories, shops, wards, nurse's stations, living quarters, children's play areas, and occupied spaces in nearby buildings.
T = 1/5	Corridors, restrooms, unattended parking lots
T = 1/20	Waiting rooms, toilets, stairways, janitor's closets, outside areas used only for pedestrians or vehicular traffic. Note: Occupancy factor of 1/20 may result in full-time exposures in non-controlled areas greater than 2 mR/hr or 100 mrem per year.

Shielding

Primary Barrier **Enter the construction material (sheetrock, concrete block, brick, etc.) and any lead shielding installed in the primary barrier(s).**	Primary Barrier #1	
	Primary Barrier #2	
Sum the material on either side of the barrier (for example, 3/8" sheetrock on two sides of a wall equals a total of 3/4"). **Enter the thicknesses for the material listed above.**	Primary Barrier #1	
	Primary Barrier #2	

Secondary Barrier **Identify each secondary barrier and enter the construction material (sheetrock, concrete block, brick, etc.) and any lead shielding installed in the secondary barrier(s).**	Secondary Barrier #1	
	Secondary Barrier #2	
	Secondary Barrier #3	
	Secondary Barrier #4	
	Secondary Barrier #5	
Sum the material on either side of each secondary barrier (for example, 5/8" sheetrock on two sides of a wall equals a total of 1.25"). **Enter the thicknesses for the material listed above.**	Secondary Barrier #1	
	Secondary Barrier #2	
	Secondary Barrier #3	
	Secondary Barrier #4	
	Secondary Barrier #5	

Minnesota Department of Health Dose Limits

4732.0430. DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE PUBLIC.

A. No registrant shall use radiation-producing equipment in a manner that could result in individual members of the public receiving an annual effective dose equivalent in excess of 0.1 rem (1.0 mSv).

B. The registrant must conduct operations so that the dose in any unrestricted area does not exceed 0.002 rem (0.02 mSv) in any one hour.

C. The registrant must show compliance with the annual public dose limit in this part, by demonstrating by measurement or calculation that the total effective dose equivalent to the individual member of the public likely to receive the highest dose from the registered operation does not exceed the annual dose limit.

4732.0410. OCCUPATIONAL DOSE LIMITS FOR ADULTS.

Subp. 1. **Applicability.** This part applies to all registrants.

Subp. 2. **Occupational dose control.** The registrant must control the occupational dose to individual adults, except for planned special exposures, pursuant to 4732.0425, to the following annual dose limit, which is the more limiting of:

A. the total effective dose equivalent being equal to five rem (0.05 Sv); or

B. the sum of the deep dose equivalent being equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem (0.5 Sv).

C. the annual limits to the lens of the eye, to the skin, and to the extremities, which are:

(1) a lens dose equivalent of 15 rem (0.15 Sv); and

(2) a shallow dose equivalent of 50 rem (0.5 Sv) to the skin or to any extremity.

4732.0415. DOSE EQUIVALENT TO AN EMBRYO/FETUS.

A. When a woman declares her pregnancy in writing, the registrant must ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5.0 mSv). Records must be kept according to part 4732.0440.

B. The registrant must ensure that efforts are made to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in item A.

C. A registrant must make a reasonable effort to limit the occupational dose to the embryo or fetus to 0.05 rem (0.5 mSv) in any one month of pregnancy, excluding medical exposure;

D. If the dose to the embryo or fetus is found to have exceeded 0.5 rem (5.0 mSv) or is within 0.05 rem (0.5 mSv) of this dose by the time the woman declares her pregnancy, the registrant must ensure that additional occupational dose equivalent to the embryo/ fetus does not exceed 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

4732.0420. EXPOSURE OF MINORS.

A registrant shall use sources of radiation in such a manner as to cause any individual within a restricted area who is under 18 years of age to receive any occupational radiation dose greater than ten percent of the annual occupational dose limits specified for adult workers in 4732.0410.

4732.0530. As Low As Reasonably Achievable (ALARA).

As low as reasonably achievable or "ALARA" means making every reasonable effort to maintain exposure to radiation as far below the dose limits as is practical, consistent with the purpose for which the registered activity is undertaken, taking into account the state of technology, the economics of improvement in relation to benefits to the public health and safety, and other societal and socioeconomic considerations.