

Shielding Manual:

Plan Approval Guidelines for X-Ray Installations

2017



Acknowledgements

The content of this x-ray shielding installation manual was modeled after the guidelines developed by the British Columbia Centre for Disease Control (BCCDC). With permission, much of the content in this document was taken directly from the *BCCDC X-ray Shielding Guidelines [1]*. Special thanks to Francine Anselmo and her team for developing the BCCDC Guideline and for permitting us to use their excellent work. A complete reference to the *BCCDC Guidelines* can be found in the [References](#) section at the end of this document.

Table of Contents

Introduction	1
How to Use This Document	1
Plan Approval Submission Form for X-Ray Installations	4
Room Layout Diagram Template	5
Definitions	6
Radiation Hazard Signage	7
Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist	8
Checklists for Medical/Chiropractic Installations	9
Checklist 1: General Radiography	9
Checklist 2: Dedicated Chest Radiography	12
Checklist 3: Fluoroscopic (Radioscopic) Radiography	14
Checklist 4: Radiographic and Fluoroscopic Radiography	16
Checklist 5: Mammographic Radiography	18
Checklist 6: Computed Tomography (CT)	20
Checklist 7: Mobile Radiography	22
Checklist 8: Chiropractic Radiography	23
Checklists for Dental Installations	25
Checklist 9: Intraoral Radiography	25
Checklist 10: Panoramic and/or Cephalometric Dental Radiography	27
Checklist 11: Cone Beam Computed Tomography (CBCT)	29
Checklists for Veterinary Installations	31
Checklist 12: Small Animal Veterinary Radiography	31
Checklist 13: Small Animal Veterinary Multi-Purpose Room Radiography	33
Checklist 14: Mobile Radiography (Veterinary)	35
Checklists for Industrial Installations	36
Checklist 15: Non-Destructive/Industrial Radiography	36
References	38

Introduction

This training manual is designed to guide the owner(s) of x-ray equipment in the design and construction of x-ray installations that would meet the approval of a radiation health officer. This training manual also summarizes the processes and requirements for submitting a plan for approval.

How to Use This Document

The purpose of this document is to aid owners, installers and contractors of medical, dental, chiropractic, veterinary and/or industrial x-ray facilities in the design and submission of an X-Ray Shielding Plan compliant with Saskatchewan's legislated and regulatory requirements. Specifically, the requirements regarding the plan of a proposed x-ray installation described in section 5-3 of *The Saskatchewan Employment Act* [2] states:

Establishment and alteration of ionizing radiation installation, installation of ionizing radiation equipment

5-3 (1) In this section and sections 5-4 and 5-7, "substantial alteration" includes:

- a) respecting any ionizing radiation equipment that emits a primary beam outside the housing of the equipment, any alteration or change of position that causes the equipment to be capable of emitting a primary beam in any direction other than the direction for which approval was granted when the plans for the installation were approved;*
- b) any alteration in the shielding properties of the room or other place in which the ionizing radiation equipment is placed or installed;*
- c) any increase in the maximum generating voltage or maximum beam current of ionizing radiation equipment in an installation; and*
- d) the placement or installation of any units of ionizing radiation equipment in an ionizing radiation installation in excess of the number of units approved when the plans for the installation were approved.*

(2) Unless a plan of the proposed installation or proposed alteration has been approved in writing by a radiation health officer, no person shall:

- a) establish or cause to be established an ionizing radiation installation for any purpose; or*
- b) make or cause to be made any substantial alteration in any ionizing radiation installation.*

(3) Subsection (2) does not apply to any prescribed ionizing radiation installation or prescribed substantial alteration.

(4) A radiation health officer may withhold approval of a plan submitted for approval pursuant to subsection (2) until the radiation health officer is satisfied that the ionizing radiation installation will be constructed or altered in a manner such that all reasonable precautions are taken to minimize the exposure of any person to radiation.

(5) No person shall use any mobile ionizing radiation equipment in any location other than one approved by a radiation health officer.

Following the latest recommendations of the International Commission on Radiological Protection (ICRP) on dose limits, the shielding specified in this document is designed to protect workers and the public outside the x-ray room to an Action Level of less than 1 millisievert (mSv) per year. **Owners wishing to shield to an exposure level greater than 1 mSv/year outside the room should not use this guideline.**

Definitions of the terminology used throughout this document are provided in the [Definitions](#) section. It is necessary to review these definitions for the proper interpretation of the shielding guidelines. The [Radiation Hazard Signage](#) section gives an overview of the signage required for diagnostic x-ray installations. The [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#) section provides information and a checklist on the proper installation of lead shielding for x-ray installations.

These guidelines contain checklists for medical and chiropractic, dental, veterinary and industry installations. Each checklist provides specific guidelines based on the intended use.

To begin, see the checklist(s) from the list below that best describe(s) your situation and read each applicable section carefully.

Medical/Chiropractic Installation

1. General
2. Dedicated Chest Radiography
3. Fluoroscopic (Radioscopic) Radiography
4. Radiographic and Fluoroscopic Radiography
5. Mammographic Radiography
6. Computed Tomography (CT)
7. Mobile Radiography
8. Chiropractic Radiography

Dental Installations

9. Intraoral Radiography
10. Panoramic and/or Cephalometric Dental Radiography
11. Cone Beam Computed Tomography (CBCT)

Veterinary Installations

12. Small Animal Veterinary Radiography
13. Small Animal Veterinary Multi-Purpose Room Radiography
14. Mobile Radiography (Veterinary)

Industrial Installations

15. Non-destructive/Industrial Radiography

Each checklist has criteria specific to the installation type. Where your facility meets the criteria given in the relevant guideline(s) and you wish to protect workers and members of the public to an exposure level at or below 1 mSv per year, you can proceed to use the checklist. Otherwise, you will need to obtain the services of a person knowledgeable and competent to carry out shielding design assessments for your facility type, prior to design and construction.

Each checklist provides an assessment table enabling you to select the amount of shielding for each barrier – e.g., walls, doors, floors, ceilings and control booths as required – taking into account occupancy factors. A diagram of a typical room layout is given to assist you in identifying each of the labeled barriers ('A', 'B', 'C', etc.). If you want to determine the shielding for a facility with more than one x-ray room, simply apply the appropriate checklist to each room individually. This applies to x-ray rooms that share common walls.

Once you have selected the shielding for each barrier, complete the [Plan Approval Submission Form for X-Ray Installations](#) (see next page) along with the required checklists and diagrams. Before you begin construction and installation, submit your plan for approval (electronic submission preferred) by e-mail, fax or mail to:

Email: radiationsafety@gov.sk.ca

Mailing Address:

Regina Office:

Ministry of Labour Relations and Workplace Safety
Radiation Safety
300 - 1870 Albert Street
Regina, Saskatchewan S4P 4W1

Saskatoon Office:

Ministry of Labour Relations and Workplace Safety
Radiation Safety
851 - 122 3rd Avenue North
Saskatoon, Saskatchewan SK S7K 2H6

Fax: 306-787-2208

Please allow at least two weeks for your plan approval submission to be processed.

Budget this much time in your schedule to avoid construction delays. Once you receive written approval from a radiation health officer, construction may proceed. Provide a copy of the completed guideline and approval to the person(s) responsible for designing the facility and for carrying out construction. Keep copies of the plan approval in your files for future reference and inspection needs.

Plan Approval Submission Form for X-Ray Installations

Once you have selected a shielding for each barrier from the *Shielding Manual*, complete this form and submit to the Ministry of Labour Relations and Workplace Safety for approval (electronic submission preferred) by e-mail, fax, or mail to:

Email: radiationsafety@gov.sk.ca

Fax: 306-787-2208

Regina Office:

Ministry of Labour Relations and Workplace Safety
Radiation Safety
300 - 1870 Albert Street
Regina, Saskatchewan S4P 4W1

Saskatoon Office:

Ministry of Labour Relations and Workplace Safety
Radiation Safety
851 - 122 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6

Please allow at least two weeks for your plan approval submission to be processed. Once you receive written approval from a radiation health officer, construction may proceed. Provide a copy of the completed guideline and approval to the person(s) responsible for designing the facility and for carrying out construction. Keep copies of the plan approval in your files for future reference and inspection needs.

Name of Owner: _____

Facility Name: _____

City _____ Province: _____ Postal Code: _____

Name of Installer: _____

Restricted Journeyperson Number: _____

X _____
Signature of Installer Date

	N/A	YES
Please confirm that your submission includes:	A completed installation of lead shielding checklist (if applicable) <input type="checkbox"/>	<input type="checkbox"/>
	A completed checklist <input type="checkbox"/>	<input type="checkbox"/>
	A room layout diagram or blue print <input type="checkbox"/>	<input type="checkbox"/>

Room Layout Diagram Template

Please attach the *Room Layout Diagram* with your [Plan Approval Submission Form for X-Ray Installation](#).

Facility Name: _____

Address: _____

City _____ Province: _____ Postal Code: _____

Name of Installer: _____

Restricted Journeyperson Number: _____

Date: _____



Scale: 1 square = _____ (include units)

Show direction
of NORTH



Definitions

Absorbed dose: the ionizing radiation energy absorbed per unit mass, expressed in grays.

Action Limit: the maximum effective dose of radiation that a worker or member of the public may receive before intervention is required. For the purposes of this document, the action limit is one millisievert (mSv) per year unless otherwise stated.

Effective dose: the sum of the products, in sieverts, obtained by multiplying the equivalent dose of radiation received by and committed to each organ by an appropriate organ weighting factor (see Table 2 of *The Radiation Health and Safety Regulations, 2005*).

Equivalent dose: the product, in sieverts, obtained by multiplying the absorbed dose of radiation and the appropriate radiation weighting factor (see Table 1 of *The Radiation Health and Safety Regulations, 2005*).

Full occupancy: applies to areas occupied by workers or other persons for a total of more than 30 minutes per day, and applies to adjacent rooms and tenanted facilities.

Gray (Gy): the special name for the SI unit of absorbed dose: 1 gray = 1 joule per kilogram.

Ionizing radiation: any atomic or subatomic particle or electromagnetic wave emitted or produced directly or indirectly by a machine or radioactive isotope and having sufficient kinetic or quantum energy to produce ionization. For the purposes of these guidelines, Ionizing Radiation specifically refers to x-rays.

Ionizing radiation equipment: a device capable of emitting ionizing radiation, but does not include:

- (i) equipment operated at less than 15 kilovolts and not designed principally to produce useful radiation;
- (ii) equipment that:
 - (A) is in storage, in transit or not being used; or
 - (B) is operated in a manner such that it cannot produce radiation;
- (iii) any radioactive substance; or
- (iv) any other prescribed equipment or category of equipment.

Ionizing radiation installation: the whole or any part of a building or other place where ionizing radiation equipment is manufactured, used, placed or installed for use.

Radiation worker: a person who, in the course of their duties, business, professional activities, studies or training:

- (i) is exposed to radiation; and
- (ii) if exposure limits, exposure levels or dose limits are specified for members of the public, might receive radiation exposure in excess of those limits or levels.

Operator: a person who uses or controls the use of any radiation equipment.

Owner: a person having management and control of a radiation installation or radiation equipment.

Partial occupancy: applies to areas occupied by workers and other persons for a total of no more than 30 minutes per day, and applies to areas such as adjacent stairwells, parkades and parking lots, lanes, gardens and infrequently used rooms (e.g., storage). Areas that can be converted from Partial Occupancy to Full Occupancy (e.g., from storage to office) should be considered as Full Occupancy for shielding requirements.

Radiation: in this context refers to ionizing radiation and specifically x-rays.

Sievert (Sv): the special name for the SI unit of both equivalent and effective dose:
1 sievert = 1 joule per kilogram.

Use: includes construct, demonstrate, test, operate, handle, repair service and maintain.

Radiation Hazard Signage

If ionizing radiation (x-ray) equipment capable of producing dose rates greater than 25 microsieverts per hour is operated, the owner of the equipment must ensure that:

- a) in the case of a room used solely for medical diagnosis of patients, a sign bearing the word “X-Ray” is prominently displayed on each door that gives access to the room;
- b) in the case of a room that houses analytical, therapy or industrial x-ray equipment, a sign bearing the word “X-Ray” or the word “Radiation” and one of the three radiation hazard symbols shown below or any other symbol approved by an officer is prominently displayed on each door that gives access to the room
- c) in the case of an open area:
 - (i) a mobile barrier is erected to enclose the area in which a dose rate greater than 25 microsieverts per hour may be produced; and
 - (ii) signs bearing the radiation hazard symbols mentioned in clause (b) are placed on the barrier so that at least one sign is always clearly visible as the area is approached.


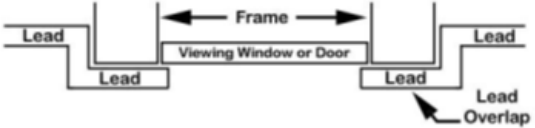
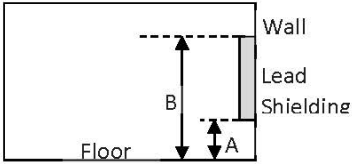


Signage must be readable and as prominent as practicable. The size of the signage must: be consistent with the size of the object to which it is affixed; permit the symbol to be recognized at a safe distance; and maintain proper proportions.

Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist

These guidelines provide owners with: (a) information on the correct procedures for installing lead and other shielding items in an x-ray facility and (b) a checklist to confirm that the installation was carried out correctly.

Facility Name: _____

Type of Lead - Check (✓) one	
1. Lead must be 99.9% pure.	<input type="checkbox"/>
2. Lead must be “rolled” sheet lead.	<input type="checkbox"/>
Installation	
3. If lead is to be attached directly to the studs, all seams must be on studs and the seams must overlap by at least 1 cm (3/8”) - see diagram below (not to scale).	<input type="checkbox"/>
	
4. If lead is epoxied to standard drywall construction, all seams must still be overlapped at least 1 cm; however, if the lead is glued on both sides and sandwiched between two layers of standard drywall construction, it is not necessary to locate seams over studs. NOTE: It is not essential to “cap” the heads of screws or nails with lead.	<input type="checkbox"/>
5. Doors must contain the same or greater amount of lead (or equivalent protection) as the walls they are installed in.	<input type="checkbox"/>
6. The control booth observation window has a lead equivalence equal to or greater than that required for the partition (or door) in which it is located.	<input type="checkbox"/>
7. Lead must overlap all doors and window frames - see diagram below (not to scale) to prevent “line of sight” openings for radiation to pass through.	<input type="checkbox"/>
	
8. The control booth barrier at the open end must extend a distance of at least 45 cm (18”) beyond the nearest edge of the control panel.	<input type="checkbox"/>
9. Electrical junction boxes must be wrapped with lead on the sides and back.	<input type="checkbox"/>
10. The vertical coverage of the lead, as illustrated, must be as follows: a) Medical Installations: $A \leq 1 \text{ ft}$; $B \geq 7 \text{ ft}$ b) Dental Installations: $A \leq 2 \text{ ft}$; $B \geq 6 \text{ ft}$	<input type="checkbox"/>
	

Checklists for Medical/Chiropractic Installations

Checklist 1: General Radiography

Before you begin, thoroughly read the [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

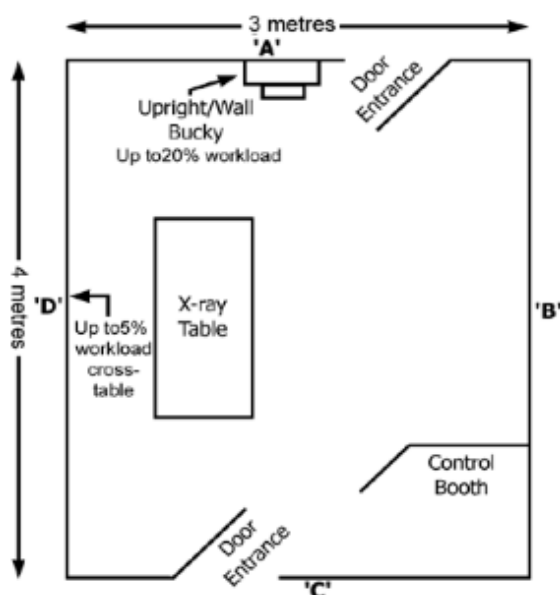
The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.

For general radiography, there are two checklist options provided depending on the facility workload. The first checklist is for facilities where the workload will not exceed 75 exposures in a 40-hour work week. The second checklist is for facilities where the workload will not exceed 960 exposures in a 40-hour work week. Choose the checklist appropriate to your situation.



ROOM LAYOUT DIAGRAM
EXAMPLE FOR GENERAL
RADIOGRAPHY

General Radiography with Workload of Up to 75 Exposures Per Week

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload (i.e., number of exposures) does not exceed 75 (on average) in a 40-hour work week schedule.		<input type="checkbox"/>
The x-ray unit is normally operated at up to 125 kVp , with a maximum image receptor (cassette) size of 35 cm x 43 cm (14" x 17") . An upright Bucky is provided which receives up to 20% of the radiographic workload and up to 5% of radiographic exposures are taken cross-table, with the remaining workload directed downwards to the floor (see next page for locations).		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 3 m x 4 m .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 75 Radiographs/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.		
Control Booth		
Shielding	0.8 mm (2 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram (up to 15 radiographs/week)		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	4 cm (1.5") regular drywall construction	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	4 cm (1.5") regular drywall construction	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	4 cm (1.5") regular drywall construction	<input type="checkbox"/>
Wall labeled 'D' on diagram (up to 4 radiographs/week cross-table)		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	4 cm (1.5") regular drywall construction	<input type="checkbox"/>
Intervening Floor (above)		
No occupancy space above x-ray room - no shielding required		<input type="checkbox"/>
Full Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	No additional shielding required	<input type="checkbox"/>
Intervening Floor (below)		
No occupancy space above x-ray room - no shielding required		<input type="checkbox"/>
Full Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	No additional shielding required	<input type="checkbox"/>

General Radiography with Workload of Up to 960 Radiographs Per Week

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload (i.e., number of exposures) does not exceed 960 (on average) in a 40-hour work week schedule.		<input type="checkbox"/>
The x-ray unit is normally operated at up to 125 kVp , with a maximum image receptor (cassette) size of 35 cm x 43 cm (14" x 17") . An upright Bucky is provided which receives up to 20% of the radiographic workload and up to 5% of radiographic exposures are taken cross-table, with the remaining workload directed downwards to the floor (see next page for locations).		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 3 m x 4 m .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required for 76 - 960 Radiographs/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{5}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.		
Control Booth		
Shielding	1.6 mm (4 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram (up to 192 radiographs/week)		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'D' on diagram (up to 4 radiographs/week cross-table)		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (above)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	10 cm (4") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (below)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	10 cm (4") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>

Checklist 2: Dedicated Chest Radiography

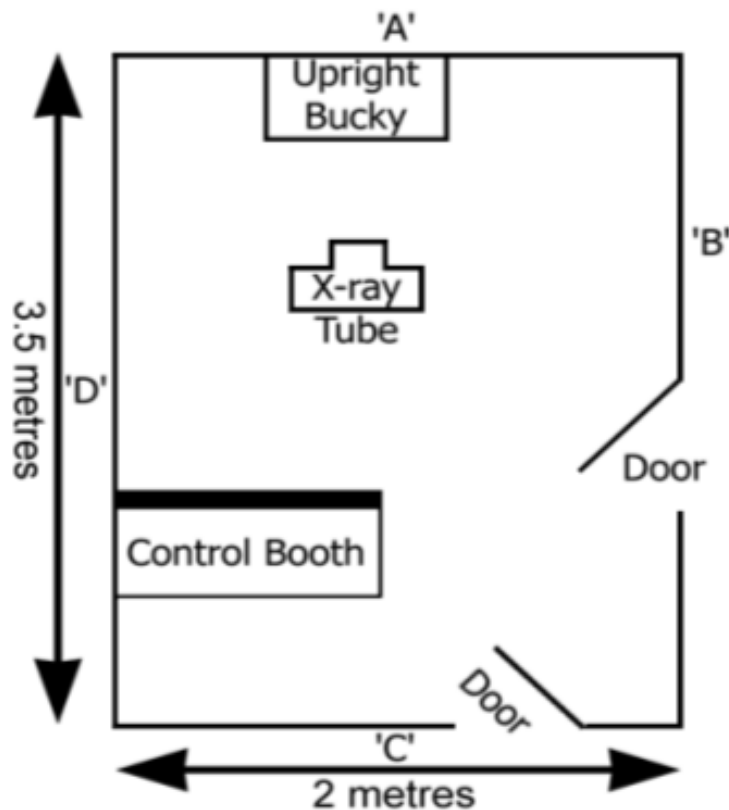
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT DIAGRAM
EXAMPLE FOR DEDICATED
CHEST RADIOGRAPHY

Dedicated Chest Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload in the room does not exceed 300 exposures in a 40-hour work week schedule.		<input type="checkbox"/>
An upright Bucky is provided which receives 100% of the radiographic workload.		<input type="checkbox"/>
The x-ray unit is normally operated at up to 125 kVp , with a maximum image receptor (cassette) size of 35 cm x 43 cm (14" x 17") .		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 2 m x 3.5 m .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 300 Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Control Booth		
Shielding	0.8 mm (2 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	5 cm (2") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead from Wall 'A' as far as control booth	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Door on Wall 'B'		
Partial Occupancy	1 mm (1/25") steel	<input type="checkbox"/>
Door on Wall 'C'		
Partial Occupancy	No additional shielding required	<input type="checkbox"/>

Checklist 3: Fluoroscopic (Radioscopic) Radiography

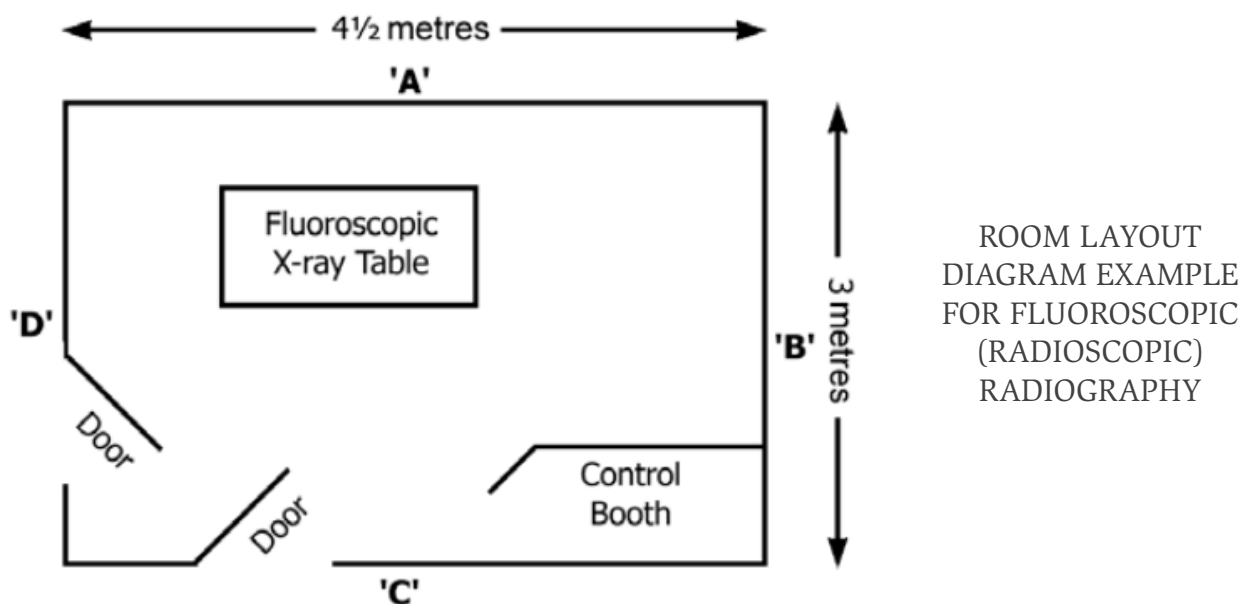
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



Fluoroscopic (Radioscopic) Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload in the room does not exceed 50 fluoroscopic (radioscopic) procedures [average fluoroscopy (radioscopy) time is 5 minutes per patient] per week.		<input type="checkbox"/>
The x-ray unit is normally operated in the range 70-100 kVp , and occasionally at up to 125 kVp .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 50 Fluoroscopy (Radioscopy) Procedures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.		
Control Booth		
Shielding	1.6 mm (4 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (above)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	7.5 cm (3") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (below)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	7.5 cm (3") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>

Checklist 4: Radiographic and Fluoroscopic Radiography

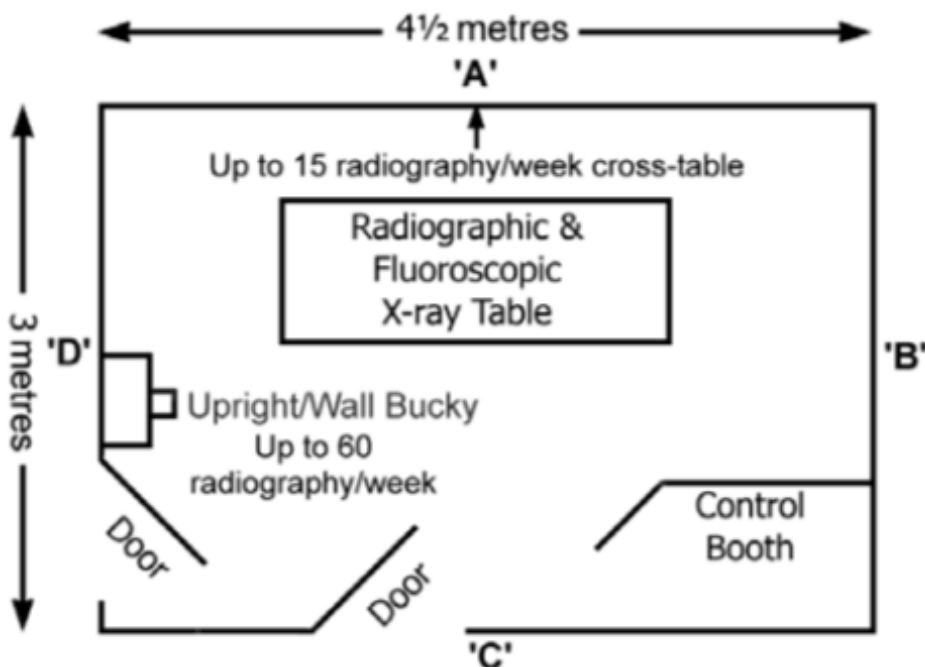
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT
DIAGRAM EXAMPLE
FOR RADIOGRAPHIC
AND FLUOROSCOPIC
RADIOGRAPHY

Radiographic and Fluoroscopic Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload in the room does not exceed 50 fluoroscopic (radioscopic) procedures [average fluoroscopy (radioscopy) time is 5 minutes per patient] and 300 radiographic exposures in a 40-hour work week schedule.		<input type="checkbox"/>
The x-ray unit is normally operated in the range 70-100 kVp , and occasionally at up to 125 kVp .		<input type="checkbox"/>
The maximum image receptor (cassette) size is 35 cm x 43 cm (14" x 17") and maximum image intensifier size is 41 cm (16") .		<input type="checkbox"/>
An upright Bucky is provided which receives up to 20% of the radiographic workload (i.e., 60 radiographs/week). Up to 5% of the radiographic workload (i.e., 15 radiographs/week) can be taken cross-table (see over for locations).		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 3 m x 4.5 m .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 50 Fluoroscopy and 300 Radiographs/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.		
Control Booth		
Shielding	1.6 mm (4 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram (up to 15 radiographic/week cross-table to Wall 'A')		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'D' on diagram (up to 60 radiographs/week directed to Wall 'D')		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (above) No occupancy space above x-ray room - no shielding required		
Full Occupancy	10 cm (4") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (below) No occupancy space above x-ray room - no shielding required		
Full Occupancy	10 cm (4") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>

Checklist 5: Mammographic Radiography

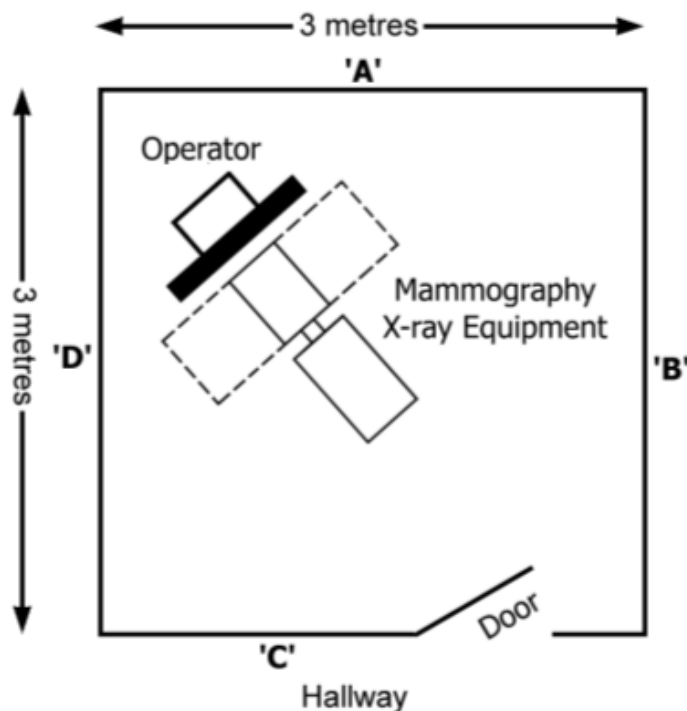
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT
DIAGRAM EXAMPLE
FOR MAMMOGRAPHIC
RADIOGRAPHY

Mammographic Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The x-ray unit is operated at up to 35 kVp .		<input type="checkbox"/>
The room containing the unit has dimensions of at least 3 m x 3 m .		<input type="checkbox"/>
The x-ray workload (number of exposures) per 40-hour workweek does not exceed 1200 .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 1200 Mammographic Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Control Booth		
Shielding	0.3 mm equivalent lead glass or lead acrylic material	<input type="checkbox"/>
Wall labeled 'A' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Door		
Partial Occupancy	2.5 cm (1") solid wood or 1.0 mm (1/25") steel	<input type="checkbox"/>
Intervening Floor (above)		<input type="checkbox"/>
No additional shielding required		
Intervening Floor (below)		<input type="checkbox"/>
No additional shielding required		

Checklist 6: Computed Tomography (CT)

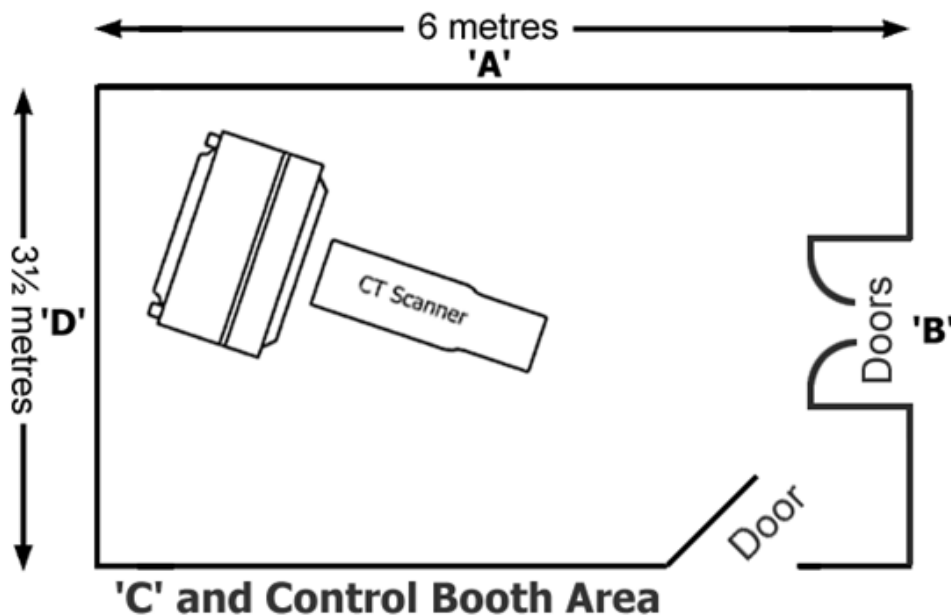
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT
DIAGRAM
EXAMPLE FOR
COMPUTED
TOMOGRAPHY

Computed Tomography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The current/future x-ray workload does not exceed 200 patients/week per 40-hour work week schedule.		<input type="checkbox"/>
The CT unit is operated at up to 150 kVp .		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 3.5 m x 6 m (see previous page).		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 200 patients/week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.		
Control Booth and Wall 'C'		
Shielding	1.6 mm (4 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (above)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	15 cm (6") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	7.5 cm (3") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Intervening Floor (below)		
No occupancy space above x-ray room - no shielding required		
Full Occupancy	15 cm (6") solid concrete or 1.6 mm (4 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	7.5 cm (3") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>

Checklist 7: Mobile Radiography

Before you begin, thoroughly read the [Introduction](#) for instructions on how to use the next checklist. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

Mobile x-ray equipment used routinely in one location must be considered as a fixed installation and the shielding needs for the equipment and room must be determined accordingly. If the mobile unit will be used primarily in one location, refer to one of the other guidelines in this manual that best matches the mobile unit's primary usage.

Criteria

The following criteria must apply in order to use this guide. For further guidance on medical radiography safety, refer to Health Canada's most current and relevant safety code publication (i.e., *Safety Code 35 [3]* or its successor).

Mobile Radiography

Facility Name: _____ Room Name: _____

As there will not be a fixed location for a mobile x-ray unit, a room specific shielding guideline is not provided. For the mobile x-ray unit plan approval submission, please provide an outline of your facility's radiation safety program as it pertains to the safe operation of mobile x-ray equipment.

CRITERIA CHECKLIST	
The unit will be mobile and not be primarily fixed in one location.	<input type="checkbox"/>
During operation, the x-ray beam will be directed away from occupied areas if at all possible, and every effort will be made to ensure that this beam does not irradiate any other persons in the vicinity of the patient.	<input type="checkbox"/>
The operator will be least 3 metres from the x-ray tube unless wearing personal protective equipment or standing behind a leaded shield.	<input type="checkbox"/>
For capacitor discharge units, appropriate precautions will be taken to fully discharge the unit before the unit is left unattended.	<input type="checkbox"/>
Owners and operators of the x-ray unit will adhere to best safety practices as laid out in Health Canada's most current and relevant safety code (i.e., <i>Safety Code 35</i> or its successor).	<input type="checkbox"/>
A dose monitoring program will be used to monitor exposure to the operators of the mobile x-ray equipment.	<input type="checkbox"/>

Please include:

1. An outline of the required personal protective equipment for operators and assistants including any requirements for shielding aprons and collars, or barriers; and
2. An outline of the worker dose monitoring protocol to be put in place.

Checklist 8: Chiropractic Radiography

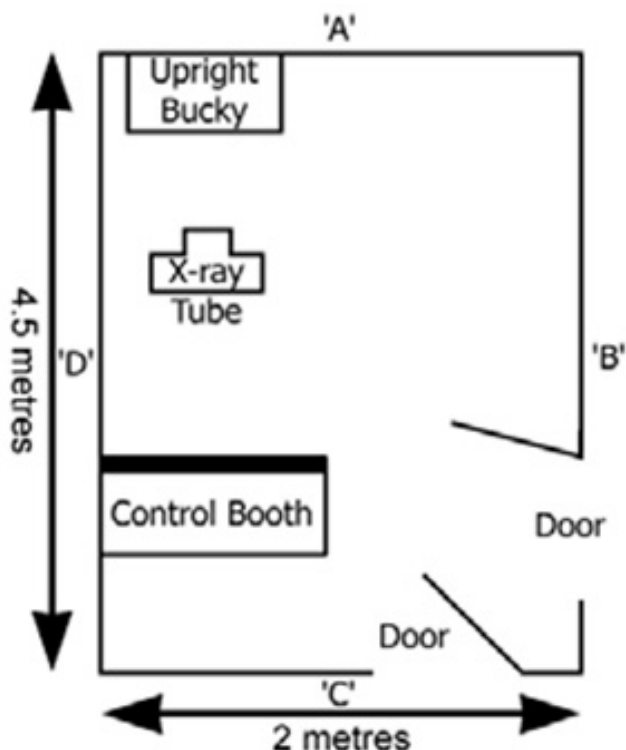
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT
DIAGRAM EXAMPLE
FOR CHIROPRACTIC
RADIOGRAPHY

Chiropractic Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
A current/future x-ray workload does not exceed 20 exposures in a 40-hour work week schedule, with the primary beam directed to an upright Bucky.		<input type="checkbox"/>
The x-ray unit is operated at up to 100 kVp , with a maximum image receptor (cassette) size of 35 cm x 43 cm (14" x 17").		<input type="checkbox"/>
The room containing the unit has dimensions no smaller than 2 m x 4.5 m .		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* 20 Bucky & 2 Extremity Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Control Booth		
Shielding	0.8 mm (2 lb/ft ²) lead and its equivalent for view window	<input type="checkbox"/>
Wall labeled 'A' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	0.8 mm (2 lb/ft ²) lead from Wall 'A' as far as control booth	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Door on Wall 'B'		
Full Occupancy	1.3 mm steel	<input type="checkbox"/>
Partial Occupancy	Standard material adequate	<input type="checkbox"/>
Door on Wall 'C'		
Full Occupancy	1.3 mm steel	<input type="checkbox"/>
Partial Occupancy	Standard material adequate	<input type="checkbox"/>
Intervening Floor (above)		
Full Occupancy	No occupancy space above x-ray room - no shielding required	<input type="checkbox"/>
Full Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	No additional shielding required	<input type="checkbox"/>
Intervening Floor (below)		
Full Occupancy	No occupancy space above x-ray room - no shielding required	<input type="checkbox"/>
Full Occupancy	5 cm (2") solid concrete or 0.8 mm (2 lb/ft ²) lead	<input type="checkbox"/>
Partial Occupancy	No additional shielding required	<input type="checkbox"/>

Checklists for Dental Installations

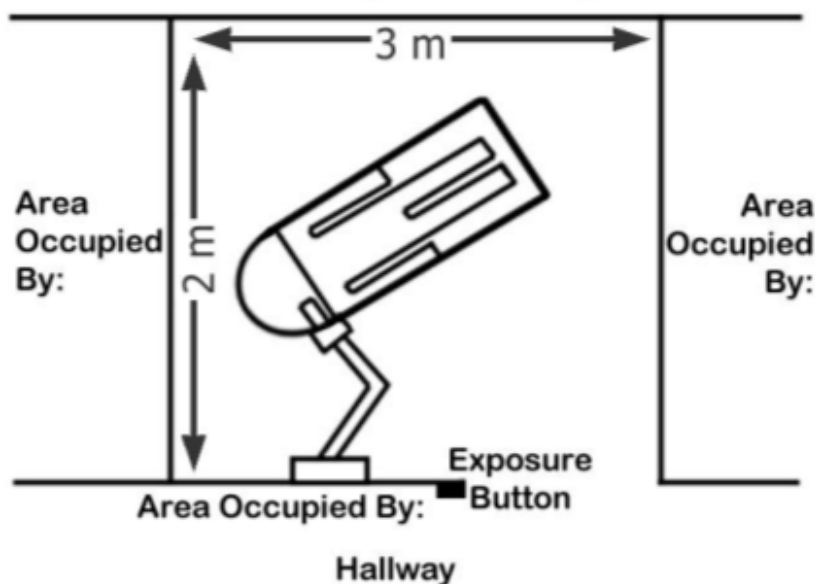
Checklist 9: Intraoral Radiography

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.



ROOM LAYOUT
DIAGRAM EXAMPLE
FOR INTRAORAL
RADIOGRAPHY

Intraoral Radiography

Facility Name: _____ Room: _____

CRITERIA CHECKLIST		
The x-ray unit is operated in the range from 60 kVp to 90 kVp .	<input type="checkbox"/>	
The room containing the x-ray unit has dimensions of at least 2 m x 3 m .	<input type="checkbox"/>	
The x-ray workload (number of exposures) per work week does not exceed 150 .	<input type="checkbox"/>	
SHIELDING CHECKLIST		
Check the box that corresponds to the workload (exposures/week) for your operatory.		
Shielding Required (per operatory)		
Regular Drywall Construction:	$\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ²	
	$\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²	
UP TO 20 Exposures Per Week	21 TO 100 Exposures Per Week	101 TO 150 Exposures Per Week
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
No physical shielding barriers required	2.5 cm (1") regular drywall construction for walls and/or 1 cm (3/8") glass and/or standard dental cabinetry	3.8 cm (1.5") regular drywall construction for walls and/or 1.5 cm (5/8") glass and/or standard dental cabinetry

Note: Shielding walls are not required adjacent to the foot of the patient bed (chair).

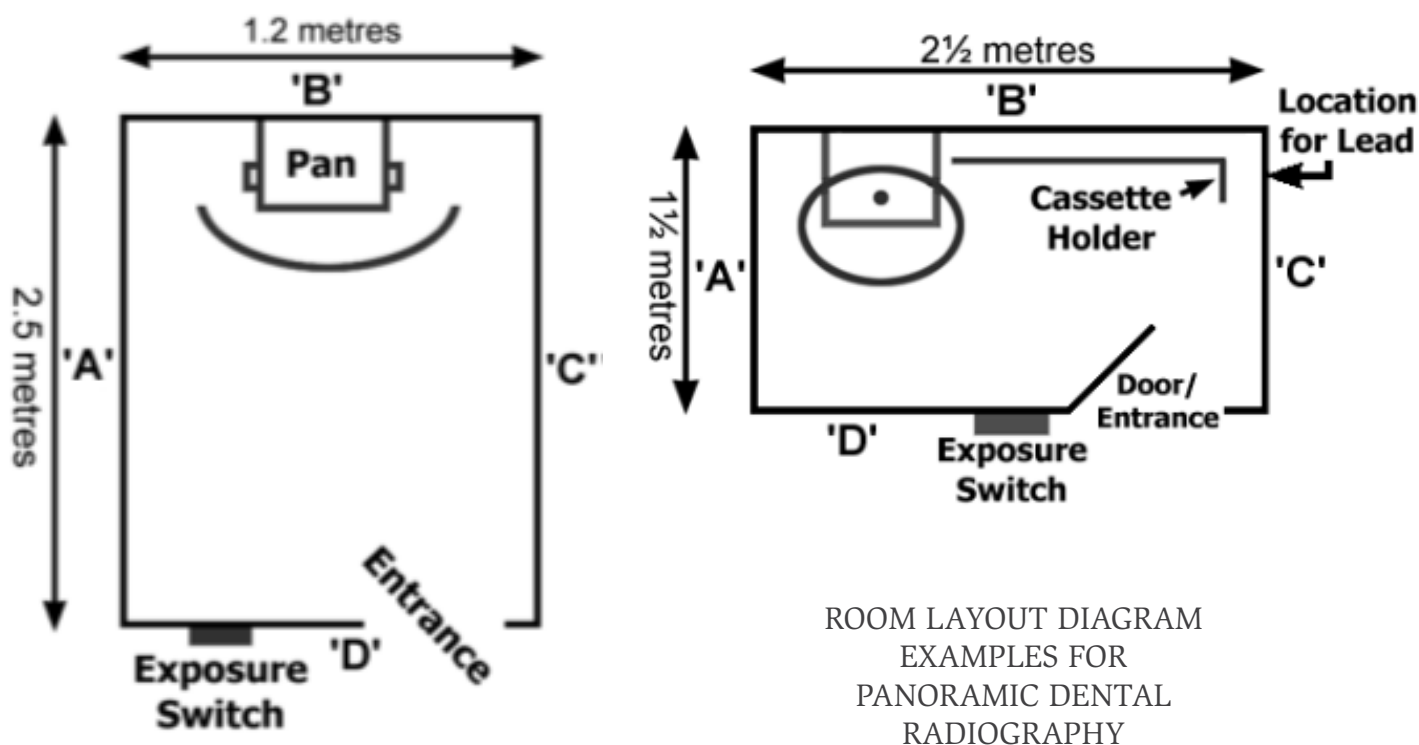
Checklist 10: Panoramic and/or Cephalometric Dental Radiography

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.



Panoramic and/or Cephalometric Dental Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The x-ray unit is operated in the range from 60 kVp to 100 kVp .		<input type="checkbox"/>
The x-ray room has dimensions of at least 1.2 m x 2.5 m (Panoramic) or 1.5 m x 2.5 m (Cephalometric)."		<input type="checkbox"/>
The x-ray workload (number of exposures) per workweek does not exceed 150 .		<input type="checkbox"/>
When taking the x-ray exposure the operator will be capable of viewing the patient, while remaining outside the room, either through a glass window in the wall or via a mirror installed at the entrance.		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 50 Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Shielding for Panoramic Unit Only (Diagram 1)		
Exposure Switch Location/ Wall 'D'	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Walls Labeled 'A', 'B' and 'C'	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Entrance Door Partial Occupancy	No shielding required	<input type="checkbox"/>
Shielding for Panoramic/Cephalometric Unit (Diagram 2)		
Exposure Switch Location/ Wall 'D'	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Wall Label 'A' Full/Partial Occupancy	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Wall Label 'B' Full Occupancy	5.0 cm (2") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Wall Label 'C'	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Cassette holder with 0.8 mm lead lining		
Cassette holder with no lead lining Full Occupancy	0.8 mm (2 lb/ft ²) rolled lead to a height of 2 metres (7 ft) and a width of 0.9 metres (3 ft) centered on the wall behind cassette holder with the primary beam	<input type="checkbox"/>
Cassette holder with no lead lining Partial Occupancy	2.5 cm (1") regular drywall construction and/or 1 cm (3/8") glass	<input type="checkbox"/>
Door/Entrance & Wall Labeled 'D'	No additional shielding required	<input type="checkbox"/>

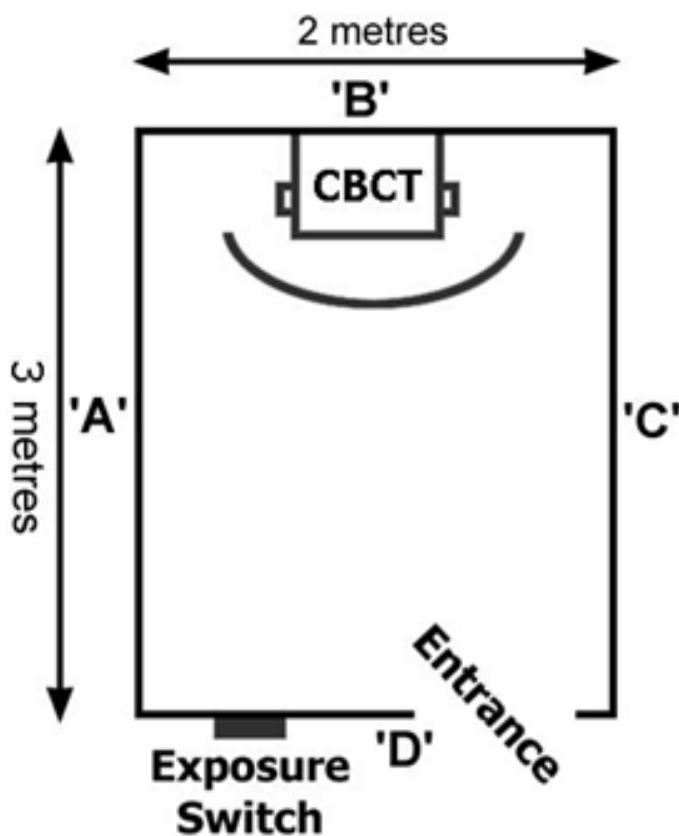
Checklist 11: Cone Beam Computed Tomography (CBCT)

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.



ROOM LAYOUT DIAGRAM
EXAMPLES FOR CONE
BEAM COMPUTED
TOMOGRAPHY

Cone Beam Computed Tomography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The x-ray unit is normally operated at up to 90 kVp .		<input type="checkbox"/>
The x-ray workload (number of exposures) per work week does not exceed 30 panoramic exposures and 15 CBCT exposures.		<input type="checkbox"/>
The room containing the x-ray unit has dimensions of at least 2 m x 3 m .		<input type="checkbox"/>
The distance of the scatter source (the patient's head) to Wall 'B' is between 75 cm - 100 cm .		<input type="checkbox"/>
The distance of the scatter source (the patient's head) to either Walls 'A' and 'C' will not be less than 100 cm .		<input type="checkbox"/>
The effective dose (exposure) per CBCT scan at 1 metre will not exceed 15 µSv (1.7 mR) in any direction.		<input type="checkbox"/>
The effective dose (exposure) per Panoramic scan at 1 metre will not exceed 5 µSv (0.6 mR) in any direction.		<input type="checkbox"/>
The operator will be outside the room behind Wall 'D'.		<input type="checkbox"/>
The operator will be able to see the patient via viewing window or system of mirrors or video monitor.		<input type="checkbox"/>
Staff working around the CBCT will be monitored by dosimeter badges.		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding Required* up to 50 Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Shielding for Cone Beam CT Unit		
Exposure Switch Location/ Wall 'D' Full Occupancy	0.8 mm (1") regular drywall construction	<input type="checkbox"/>
Exposure Switch Location/ Wall 'D' Viewing System Full Occupancy	0.9 cm (11/32") plate glass or system of mirrors or video monitor	<input type="checkbox"/>
Wall Labeled 'A' and 'C' Full Occupancy	0.8 mm (2 lb/ft ²) lead or 25mm concrete	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Wall Labeled 'B' Full Occupancy	0.8 mm (2 lb/ft ²) lead or 30mm concrete	<input type="checkbox"/>
Partial Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Door/Entrance & Wall Labeled 'D'	No additional shielding required	<input type="checkbox"/>

Checklists for Veterinary Installations

Checklist 12: Small Animal Veterinary Radiography

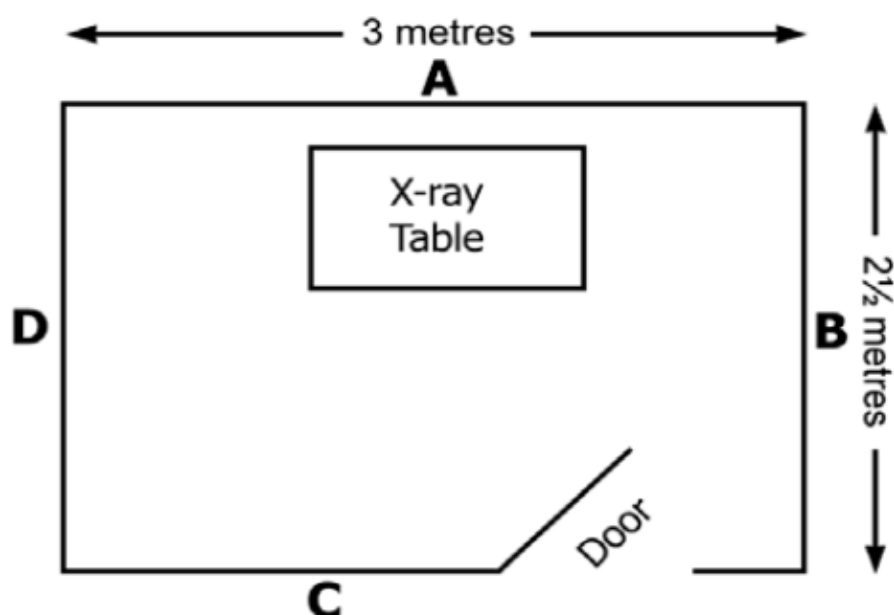
Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) below the x-ray room, protection for these areas must be provided in the intervening floors.



ROOM LAYOUT
DIAGRAM EXAMPLES
FOR SMALL ANIMAL
VETERINARY
RADIOGRAPHY

Small Animal Veterinary Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST		
The x-ray unit is operated at up to 100 kVp and is equipped with a beam-limiting device.		<input type="checkbox"/>
The room containing the unit has dimensions of at least 2.5 m x 3 m .		<input type="checkbox"/>
The x-ray workload (number of exposures) per work week does not exceed 40 and the primary x-ray beam is directed vertically down towards the floor. This workload allows for up to two horizontal (cross-table) exposures per week, provided the x-ray beam is directed either to a wall located at least 2.5m from the x-ray tube or to a wall beyond which there is partial occupancy or where there is no occupancy.		<input type="checkbox"/>
The maximum image receptor (cassette) size is 35 cm x 43 cm (14" x 17"); smaller sizes are also used.		<input type="checkbox"/>
Workers directly involved in taking x-rays and holding small animals will wear appropriate protection (i.e., lead aprons/gloves (thyroid collars are recommended)) to ensure that their doses do not exceed the maximum permissible doses for the whole body, hands and other organs/tissues and that doses are kept as low as is reasonably achievable. Lead aprons used will provide protection equivalent to at least 0.25 mm of lead.		<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area		
Area (see Room Layout Diagram)	Shielding for up to 40 Exposures/Week	
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ²		
Wall labeled 'A' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	No shielding required	<input type="checkbox"/>
Wall labeled 'B' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	No shielding required	<input type="checkbox"/>
Wall labeled 'C' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	No shielding required	<input type="checkbox"/>
Wall labeled 'D' on diagram		
Full Occupancy	2.5 cm (1") regular drywall construction	<input type="checkbox"/>
Partial Occupancy	No shielding required	<input type="checkbox"/>
Door		
Full Occupancy	2.5 cm (1") solid wood or 1 mm (1/25") steel	<input type="checkbox"/>
Partial Occupancy	No shielding required	<input type="checkbox"/>
Floor (room below)		
Full Occupancy	5 cm (2") of concrete or 0.8 mm (2 lb/ft ²) lead sheet with minimum dimensions of 80 cm X 80 cm below the x-ray table	<input type="checkbox"/>
Partial Occupancy	2 mm (1/16") thick steel below x-ray table	<input type="checkbox"/>

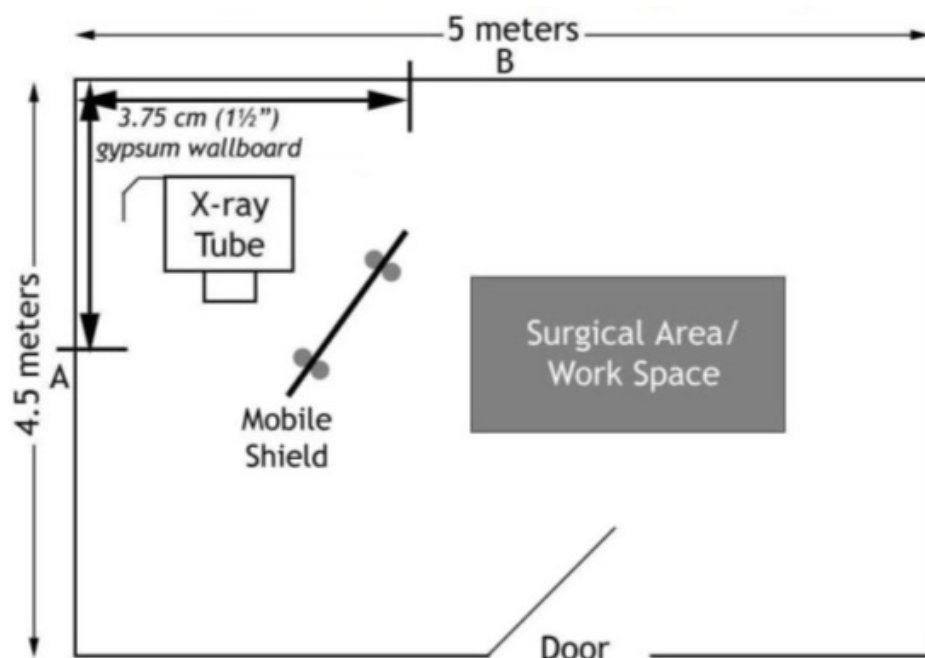
Checklist 13: Small Animal Veterinary Multi-Purpose Room Radiography

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.



ROOM LAYOUT
DIAGRAM EXAMPLES
FOR SMALL ANIMAL
VETERINARY MULTI-
PURPOSE ROOM
RADIOGRAPHY

Small Animal Veterinary Multi-Purpose Room Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST	
The x-ray unit is operated at up to a maximum 70 kVp and 6 to 15 mAs per exposure , is equipped with a beam-limiting device and the useful x-ray beam is directed away from areas occupied by staff.	<input type="checkbox"/>
The x-ray workload (number of exposures) per year will not exceed 2000 (~ 165/month).	<input type="checkbox"/>
The maximum image receptor (cassette) size is 35 cm x 43 cm (14" x 17"); smaller cassettes are also used.	<input type="checkbox"/>
Workers directly involved in taking x-rays and holding small animals will wear appropriate protection (i.e., lead aprons/gloves (thyroid collars are recommended)).	<input type="checkbox"/>
The veterinary facility owner utilizing a multi-purpose room will evaluate the radiation exposure of staff working within the room by providing personal dosimeters and ensuring they are worn appropriately. The results of dosimetry will be reviewed to determine the effectiveness of the protective measures.	<input type="checkbox"/>
Consideration should be given to the use of mobile shielding , placed between the x-ray tube and the surgical area (see diagram on previous page) or to provide each radiation worker in the room with a lead apron (thyroid collar recommended).	<input type="checkbox"/>
If mobile shielding is used, it has minimum dimensions of 75 cm W x 120 cm H (30" W x 48" H) and provides protection to a minimum of 0.1 mm lead equivalent . Mobile shielding with adjustable heights are also acceptable.	<input type="checkbox"/>
Lead aprons provide protection equivalent to at least 0.25 mm of lead .	<input type="checkbox"/>
Workers in the room at less than three metres from the x-ray tube are likely to exceed 1 mSv/yr, if additional protection (mobile shield; lead aprons) is not provided. These workers will be subject to an exposure control plan, which the veterinary facility owner will establish.	<input type="checkbox"/>
Dosimeters used by staff to measure their body doses will be worn underneath the lead apron. Additional dosimeters may be used to determine doses to other parts of the body (e.g., head, hands). Contact your dosimetry service provider for details on suitable dosimeter types and wearing methods.	<input type="checkbox"/>
SHIELDING CHECKLIST - Check (✓) one per area	
Area (see Room Layout Diagram)	Shielding for up to 40 Exposures/Week
Regular Drywall Construction: $\frac{1}{2}$ " = 1.6 lbs/ft ² 7.8 kg/m ² $\frac{3}{8}$ " = 2.2 lbs/ft ² 10.7 kg/m ² Note: Doors require same shielding as their walls.	
Wall labeled 'A' and 'B' on diagram	
	Staff outside the room, in adjacent areas
Full Occupancy	3.75 cm (1½") regular drywall construction <input type="checkbox"/>
Partial Occupancy	No additional shielding required <input type="checkbox"/>
	Staff working within multi-purpose room
Surgical Area/Workspace at Full Occupancy	Mobile lead shielding and/or lead aprons <input type="checkbox"/>
	Dosimeters worn by all radiation workers <input type="checkbox"/>

Checklist 14: Mobile Radiography (Veterinary)

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

Mobile x-ray equipment used routinely in one location must be considered as a fixed installation and the shielding needs for the equipment and room must be determined accordingly. If the mobile unit will be used primarily in one location, refer to one of the other guidelines in this manual that best matches the mobile unit's primary usage.

Criteria

The following criteria must apply in order to use this guide. For further guidance on veterinary radiography safety, refer to Health Canada's most current and relevant safety code publication (i.e., *Safety Code 28 [4]* or its successor).

Mobile Radiography (Veterinary)

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST	
The unit will be mobile and not be primarily fixed in one location.	<input type="checkbox"/>
During operation, the x-ray beam will be directed away from occupied areas if at all possible, and every effort will be made to ensure that this beam does not irradiate any other persons in the vicinity of the patient.	<input type="checkbox"/>
The operator will be least 3 metres from the x-ray tube unless wearing personal protective equipment or standing behind a leaded shield.	<input type="checkbox"/>
For capacitor discharge units, appropriate precautions will be taken to fully discharge the unit before the unit is left unattended.	<input type="checkbox"/>
Owners and operators of the x-ray unit will adhere to best safety practices as laid out in Health Canada's most current and relevant safety code (i.e., <i>Safety Code 28</i> or its successor).	<input type="checkbox"/>
A dose monitoring program will be used to monitor exposure to the operators of the mobile x-ray equipment.	<input type="checkbox"/>

As there will not be a fixed location for a mobile x-ray unit, a room specific shielding guideline is not provided. For the mobile x-ray unit plan approval submission, please provide an outline of your facility's Radiation Safety Program as it pertains to the safe operation of mobile x-ray equipment.

Please include:

- An outline of the required personal protective equipment (PPE) for operators and assistants including any requirements for shielding aprons, collars or barriers; and
- An outline of the dose monitoring protocol (dosimeter program) to be put in place.

Checklists for Industrial Installations

Checklist 15: Non-Destructive/Industrial Radiography

Before you begin, thoroughly read [How to Use This Document](#) for instructions on how to use the next checklist and diagram. The checklist is divided into criteria and shielding sections. The use of this checklist is permissible only if all prescribed conditions in the criteria checklist are met. If all criteria cannot be met, you will need to obtain the services of a person knowledgeable and competent in radiation shielding to carry out shielding design assessments.

The room layout diagram example is provided to orientate the position and direction of the x-ray unit relative to the walls of the room. Each wall in the diagram is labeled with a letter which is referenced in the shielding checklist.

For shielding installation requirements, see [Installation of Lead Shielding in a Diagnostic X-Ray Facility Checklist](#). For requirements on proper signage, refer to [Radiation Hazard Signage](#).

The shielding options allow for consideration of the amount of time (occupancy) spent by persons outside each of the barriers (e.g., walls/doors). (Refer to the [Definitions](#) of full and partial occupancy.) Areas that can be converted from partial occupancy to full occupancy (e.g., from storage to office) should be considered as full occupancy for shielding requirements.

If the facility has accessible areas (e.g., rooms) above and/or below the x-ray room, protection for these areas must be provided in the intervening floors.

Criteria

The following criteria must apply in order to use this guide. For further guidance on industrial radiography safety, refer to Health Canada's most current and relevant safety code publication (i.e., *Safety Code 34 [5]* or its successor).

Criteria Checklist for Industrial Radiography

Facility Name: _____ Room Name: _____

CRITERIA CHECKLIST	
Emitter is an x-ray generator (gamma sources such as Iridium-192 (^{192}Ir), cesium-137 (^{137}Cs) or cobalt-60 (^{60}Co) are regulated under federal law).	<input type="checkbox"/>
A radiation safety officer (RSO) will be appointed to oversee and implement a radiation safety program.	<input type="checkbox"/>
The radiation safety program will follow the recommendations of Health Canada's most current safety code regarding industrial x-ray practices (i.e., <i>Safety Code 34</i> or its successor).	<input type="checkbox"/>
Industrial radiographers and other users will wear photon-sensitive passive dosimeters as well as instantaneous reading electronic alarm dosimeters.	<input type="checkbox"/>

Non-Destructive Industrial Radiography

Facility Name: _____ Room Name: _____

PERMANENT INSTALLATIONS SHIELDING CHECKLIST	
A supervised area around the x-ray work will be delineated by suitable means.	<input type="checkbox"/>
Appropriate signage will be posted in appropriate positions around the supervised area.	<input type="checkbox"/>
Safety procedures will be subject to periodic review by RSO.	<input type="checkbox"/>
MOBILE INSTALLATIONS SHIELDING CHECKLIST	
A controlled area will be established to facilitate the radiographic work required.	<input type="checkbox"/>
A calibrated and functional survey meter will be used to ensure that the equivalent dose rate at the boundary of the controlled area does not exceed 0.1 mSv per hour.	<input type="checkbox"/>
Appropriate signals (visible from at least 10 metres) and audible warnings (loudspeaker, horns) that alert unauthorized personnel of radiography in the controlled area will be established.	<input type="checkbox"/>
At least two individuals, authorized by the RSO, will monitor the boundary of the controlled area and to ensure unauthorized individuals do not enter inside the controlled area during ionizing radiation generation.	<input type="checkbox"/>
Where possible, a temporary radiation control station external to the designated controlled area will be used for the initiation, generation or termination of ionizing radiation and for real-time image acquisition and assessment.	<input type="checkbox"/>
The attendant industrial radiographer will have appropriate documentation which substantiates that the portable x-ray equipment that is used on site has been duly registered.	<input type="checkbox"/>
All controls, lights, warning signals or other indicators associated with industrial radiography at a temporary site will: (i) be clearly labeled; (ii) be imbedded with the appropriate warning text.	<input type="checkbox"/>

References

1. *British Columbia Center for Disease Control (BCCDC) X-ray Shielding Guidelines*
<http://www.bccdc.ca/health-info/health-your-environment/radiation/radiation-issue-notes-x-ray-shielding-guidelines-and-other-useful-documents>
2. *The Saskatchewan Employment Act*
<http://www.publications.gov.sk.ca/redirect.cfm?p=70351&i=78194>
3. *Health Canada Safety Code 35: Safety Procedures for the Installation, Use and Control of x-ray Equipment in Large Medical Radiological Facilities, 2008*
http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/safety-code_35-securite/index-eng.php
4. *Health Canada Safety Code 28: Radiation Protection in Veterinary Medicine, 1991*
<http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/91ehd-dhm151/index-eng.php>
5. *Health Canada Radiation Protection and Safety for Industrial X-ray Equipment; Safety Code 34, 2003*
http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/safety-code_34-securite/index-eng.php
6. *Radiation Emitting Devices Act, 1985*
<http://laws-lois.justice.gc.ca/PDF/R-1.pdf>
7. *The Radiation Health and Safety Regulations, 2005*
<http://www.publications.gov.sk.ca/redirect.cfm?p=9623&i=14595>

Shielding Manual:

Plan Approval Guidelines for X-Ray Installations

2017

For more information, please contact the Ministry of Labour Relations and Workplace Safety Occupational Health and Safety Division at:

Regina

300 - 1870 Albert Street
Regina, Saskatchewan S4P 4W1

Inquiry: 306-787-4496
Toll Free: 1-800-567-7233

Saskatoon

8th Floor, 122 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6

Inquiry: 306-933-5052
Toll Free: 1-800-667-5023