RADIATION SHIELDING GUIDELINES

for

Low Risk Medical X-ray Facilities

This guideline is intended to assist owners of low risk facilities with medical x-ray equipment, their representatives and other relevant parties to assess the radiation shielding requirements for registration of that equipment and premises under the Radiation Safety Act 1973.

Premises where dental (intraoral, panoramic or cephalometric), mammographic and bone densitometry (dual energy x-ray absorption) x-ray equipment is kept or used are considered a low radiation risk as the potential for radiation exposure is minimal and additional shielding is generally not required to ensure that occupational and public dose limits are within requirements.

This document identifies the circumstances under which the assessment of structural radiation protection for these facilities is to be undertaken by way of a self-assessment.

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The requirements which are stated as 'must' statements are mandatory.

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1. General Requirements

1.1 Design Constraints

Schedule I of the Radiation Safety (General) Regulations 1983 sets out the dose limits and maximum permissible exposure levels for radiation workers and members of the public.

The Radiological Council applies more conservative dose constraints to the assessment of premises structural radiation protection; these are 10% of the occupational and 50% of the public annual effective dose limits (2 mSv and 0.5 mSv respectively).

These conservative guidelines acknowledge that the dose limits have been consistently reduced over time and apply the ALARA principle, as recommended by the International Commission on Radiological Protection.

1.2 Low Risk Facilities

With regard to radiation shielding, low risk medical facilities are considered to be those where the potential for radiation exposure (other than for the patient) is minimal and shielding additional to typical building materials is generally not required to ensure that occupational and public dose limits are within requirements specified by the Radiological Council.

With regard to shielding requirements, facilities for the following types of x-ray equipment may be regarded as low risk:

- dental intraoral
- dental panoramic or cephalometric
- mammographic
- dual energy x-ray absorptiometry (DEXA)

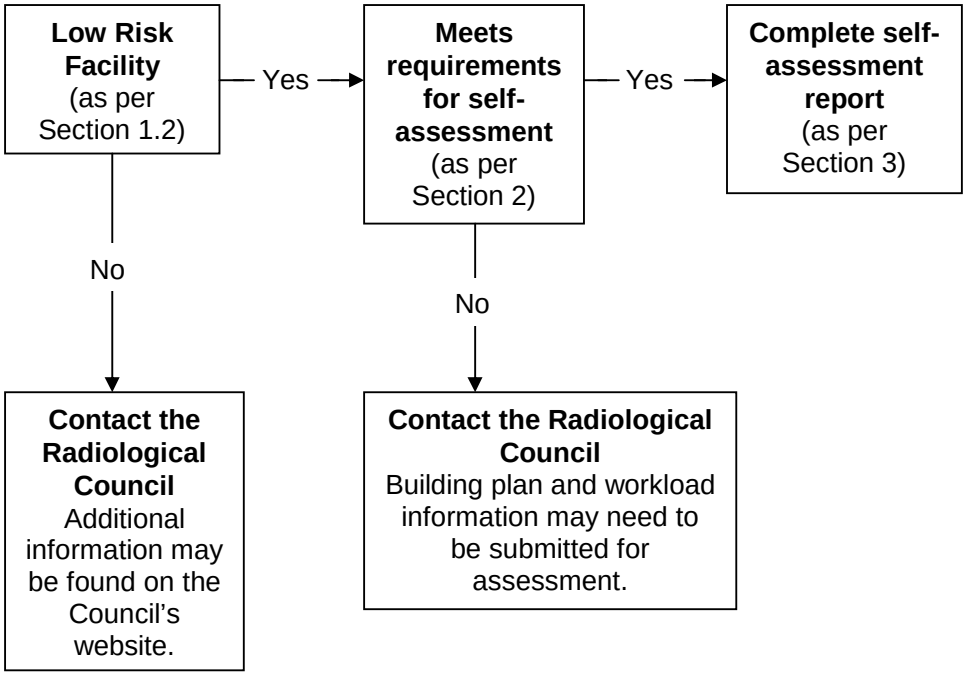
1.3 Shielding Self-Assessment

For most low risk facilities, a radiation shielding assessment may be carried out by the owners of the x-ray equipment. Section 2 identifies the requirements for the shielding of facilities to be self-assessed.

Where a self-assessment must be undertaken, the registrant must ensure that a written shielding self-assessment report has been prepared and is forwarded to the Radiological Council at the time of registration. Section 3 provides the details of information that must be documented in the shielding self-assessment report.

Where premises do not meet the requirements of Section 2 for self-assessment, a building plan and workload information, or a shielding report from a suitably qualified person, must be submitted to the Radiological Council.

Flow chart for shielding assessment requirements:



2. Shielding Requirements

2.1 Dental Radiography – Intraoral

A room used for intraoral dental radiography does not require additional shielding beyond that provided by typical building materials (e.g. normal plasterboard, glass or brick barriers) if the workload and minimum distance requirements in table 1 are met.

Unless necessary for the immediate care of the patient, the operator and all other personnel must either remain outside the room and behind a wall barrier during x-ray exposures or at a distance of at least two metres from the patient's head.

Facilities that meet the requirements of table 1 may be self-assessed. In this case the registrant must ensure that a self-assessment report is completed for the installation (refer to section 3).

Table 1. Minimum permitted distance from the patient to the barrier as a function of workload.

Exposures per week	Minimum distance between the patient's head and the barrier		
	20 mm plasterboard	12 mm plate glass	5 mm plate glass
100	1 metre	1 metre	1.5 metres
200	1.5 metres	1.5 metres	2 metres
300	2 metres	2 metres	2.5 metres

A premises plan and workload information must be submitted to the Radiological Council when facilities do not meet the workload or distance requirements specified in table 1.

2.2 Dental Radiography – Panoramic and Cephalometric

A room used for panoramic and/or cephalometric dental radiography does not require additional shielding beyond that provided by typical building materials (e.g. normal plasterboard, glass or brick barriers) if the workload and minimum distance requirements in table 2 are met. The OPG unit is not to be installed in a public area within the practice (i.e. in a waiting room).

Unless necessary for the immediate care of the patient, the operator and all other personnel must either remain outside the room and behind a wall barrier during x-ray exposures or at a distance of at least two metres from the patient's head.

The operator must be able to view the patient and x-ray tube during all exposures.

Facilities that meet the requirements of table 2 may be self-assessed. In this case the registrant must ensure that a self-assessment report is completed for the installation (refer to section 3).

Table 2. Minimum permitted distance from the patient to the barrier as a function of workload.

Exposures per week	Minimum distance between the patient's head and the barrier		
	20 mm plasterboard	12 mm plate glass	5 mm plate glass
20	0.7 metres	0.7 metres	1 metre
50	1 metre	1 metre	1.5 metres
100	1.5 metres	1.5 metres	2 metres

A premises plan and workload information must be submitted to the Radiological Council when facilities do not meet the workload or distance requirements specified in table 2.

2.3 Mammography

A room used solely for mammography does not require additional shielding if the following criteria are met:

- the workload is not greater that 1200 exposures per week; and
- the walls are constructed such that they offer shielding equal to or greater than that provided by a total of 26 mm plasterboard (i.e. 2 layers of 13 mm plasterboard); and
- the mammographic unit is installed such that either the patient's back faces the door or the operator's screen shields the door.

The operator must ensure that all non-essential personal leave the room during exposures. The operator's protective screen must be positioned so that the operator standing at the control panel is fully shielded from leakage radiation from the x-ray tube housing and scatter radiation arising from the patient. The window in the operator's protective screen must be of a suitable size to allow the operator to observe the patient from a fully protected position during all procedures and must be labelled with its lead equivalence at a nominal kVp.

A warning light which displays the words 'CAUTION X-RAYS' or similar must be installed at eye level adjacent to any doorway leading into the room. The light must be connected to the exposure circuit so that it illuminates in 'prep' and remains on for the duration of the exposure.

Facilities that meet these criteria may be self-assessed. In this case the registrant must ensure that a self-assessment report is completed for the

installation (refer to section 3).

A plan of the premises and the workload information must be submitted to the Radiological Council when facilities do not meet these requirements.

2.4 Dual Energy X-ray Absorptiometry (DEXA)

A room used solely for DEXA (i.e. bone densitometry) does not require additional shielding if the following criteria are met for the applicable equipment type:

- the unit is a pencil beam unit; or
- for narrow angle fan beam units operating at equal to or less than 100 kV, provided that one of the following applies to each barrier:

    i. the unit is located at least 2 m from an area that is occupied 100% of the time, with the occupied area being on the other side of a barrier which offers shielding equal to or greater than that provided by a total of 20 mm plasterboard; or

    ii. the unit is located at least 1.5 m from an area that is occupied at most 50% of the time, with the occupied area being on the other side of a barrier which offers shielding equal to or greater than that provided by a total of 20 mm plasterboard; or

    iii. the unit is located any distance from an area that is occupied at most 30% of the time, with the occupied area being on the other side of a barrier which offers shielding equal to or greater than that provided by a total of 20 mm plasterboard.

The operator must ensure that all non-essential personal leave the room during exposures. The operator's console must be placed as far from the patient and x-ray unit as practicable, but no closer than 1 m if the operator is not provided with a suitable shield, so as to minimise radiation exposure to the operator. The operator must also ensure that any other person remaining in the room during exposures is positioned as far as practical from the patient and x-ray unit.

Facilities that meet these criteria may be self-assessed. In this case the registrant must ensure that a self-assessment report is completed for the installation (refer to section 3).

Wide angle fan beam units, or narrow angle fan beam units operating at greater than 100kV, are not permitted to be self-assessed and require a premises plan and workload information to be submitted to the Radiological Council.

3. Shielding Self-Assessment Report

A shielding self-assessment report must be completed when an installation meets the requirements of Section 2. The information that must be included is specified in Section 3.1 and a report template is provided in Appendix 2.

The report and plan of the installation must be forwarded to the Radiological Council at the time of registration.

3.1 Required Documentation

The following information must be documented in the self-assessment report:

- name of the registrant (owner of the equipment)
- address of registered premises
- proposed use of premises
- location within premises/room being assessed
- x-ray equipment to be used in the room being assessed (manufacturer, model, serial number and type of x-ray equipment)
- maximum workload for the x-ray unit (exposures per week)
- documentation that supports the assessment (including a plan of the installation and reference to meeting requirements of the relevant section of this guideline)

  Where a self-assessment determines that no additional radiation shielding is required for the premises, this must be expressly stated in the report.
- name, position and signature of the registrant or radiation safety officer.

Glossary

In this document –

ALARA means that a radiation dose is as low as reasonably achievable with social and economic factors taken into account.

Dual Energy X-ray Absorption units are typically used for the purposes of bone densitometry but may also, under certain conditions, be used for the purpose of body composition analysis.

Low Risk Medical X-ray Facilities means with regard to structural radiation protection the premises where x-ray equipment is used may be considered low risk if it does not generally require additional shielding to ensure that occupational and public dose limits are within requirements.

Mammography means the use of mammographic x-ray apparatus for all diagnostic mammography examinations, including screening facilities for asymptomatic patients.

Member of the Public means any person other than a person designated as a radiation worker.

Normal Plasterboard means standard gypsum plasterboard (in accordance with the Australian Standard) with thickness no less than 10 mm.

Radiation Worker means a person who in the course of their employment may be exposed to radiation arising from their direct involvement with sources of radiation.

The Radiological Council is the independent statutory authority appointed under the Radiation Safety Act in Western Australia to assist the Minister for Health to protect public health and to maintain safe practices in the use of radiation.

APPENDIX 1: SHIELDING PROPERTIES OF COMMON BUILDING MATERIALS

Broad Beam Conditions at 100 kVp

Material	Thickness (mm)	Pb equivalence (mm)	Transmission (%)
Concrete (solid)	100	1.5	0.2
Concrete (solid)	150	2.4	0.02
Brick (solid)	110	1.5	0.2
Brick (cored)	110	0.71	1.8
Brick – special performance (cored)	150	1.3	0.2
Lead sheet (15 kg m^{-2})	1.3	1.3	0.3
Lead sheet (10 kg m^{-2})	0.88	0.88	1.1
Plasterboard (2 sheets of 13 mm gyprock)	26	0.08	35
Plate glass	5	0.04	56
Plate glass	12	0.09	31
Steel	1	0.15	20
Steel	2	0.30	8.6
Steel	3	0.44	4.6

NOTES

The lead equivalences are based on results from Radiation Health Section studies, Health Protection Agency's *Notes on Building Materials and References on Shielding Date for Use below 300 kVp*, Sutton and Williams' *Radiation Shielding for Diagnostic X-rays* and National Council on Radiation Protection and Measurements *Report No 147: Structural Shielding for Medical X-ray imaging Facilities*.

APPENDIX 2: SHIELDING SELF ASSESSMENT REPORT

Practice Name:			
Registrant:			
Premises Address:	Number and Street		
	Suburb		WA
	Postcode		
Location on Premises:			
Equipment:	Manufacturer		
	Model		
	Serial Number		
	Type of Unit		
Maximum Number of Exposures per Week			

Declaration:

I hereby confirm that a self-assessment for the above location and x-ray unit has been completed in accordance with the Radiological Council's document *Radiation Shielding Guidelines: Low Risk X-ray Facilities*.

This self-assessment has determined that no additional radiation shielding is required for the premises.

☐ Plan of the premises attached as required.

_____

Signature

_____

Name

Registrant/Radiation Safety Officer
(select appropriate)

Position

_____

Date