Test Protocol for shielding of medical, veterinary and chiropractic diagnostic X-ray apparatus 2023

Issued February 2023

This protocol provides the mandatory requirements for an accredited tester verifying shielding of X-ray apparatus used for medical, veterinary and chiropractic radiography including fluoroscopy, plain radiography, computed tomography, mammography and dental cone beam computed tomography, but excluding fluoroscopy using mini-C arm X-ray apparatus.

It should be read in conjunction with:

- *Radiation Protection and Control Act 2021* (RPC Act);
- *Radiation Protection and Control Regulations 2022* (RPC Regulations);
- *Code of Compliance for facility design and shielding 2022* published by the Department.

For calculations of shielding verification, testers should refer to either of the following documents:

- National Council on Radiation Protection and Measurements, *Structural Shielding Design for Medical X-ray Imaging Facilities* (NCRP 147), 2004; or
- British Institute of Radiology (BIR), *Radiation Shielding for Diagnostic Radiology*, 2nd edition, Report of a BIR working party, October 2010 – April 2012

Citation

This protocol may be cited as the *Test Protocol for shielding of medical, veterinary and chiropractic X-ray apparatus 2023.*

Part 1 Interpretation

Unless the contrary intention appears—

any terms used have the meaning given to them in regulation 3(1) of the regulations;

accredited tester means a person performing compliance testing who is a holder of an accreditation as a third-party service provider under section 31 of the Act;

EPA means the Environment Protection Authority, South Australia;

fixed protective screen means a protective screen that is firmly in position and not readily removable;

general duty of care means the requirements under section 53 of the Act. Applicable sections are indicated by the symbol †;

EPA South Australia

primarily used, in relation to a mobile or portable apparatus, is an apparatus that is used in a single room, space or enclosure for most of the time the apparatus is operational.

Part 2 General requirements

1 – Application of protocol

This protocol applies to X-ray apparatus used for medical, veterinary, and chiropractic radiography, including plain radiography, computed tomography, dental cone beam computed tomography, mammography and fluoroscopy including—

(a) fixed apparatus; and
(b) mobile and portable apparatus that are *primarily used* in a single room, space or enclosure, but excluding mini-C arm fluoroscopy apparatus.

2 – Complying with this protocol

The accredited tester must—

(a) perform compliance testing in accordance with the test methods specified in Part 3 and Part 4; and
(b) provide in a report—
  (i) the details as specified in sections 3 to 7; and
  (ii) the test parameters used, and results obtained for the compliance tests performed under Part 3 and Part 4 providing details regarding the following:
    - the method used, whether the report has followed the methods and assumptions of NCRP 147 or BIR 2012. Using a mixture of these methods is not permitted;
    - exposure parameters;
    - use of Phantom;
    - evidence and details regarding assumptions such as workload.
  (iii) complete the approved Certificate of Compliance for Shielding of Medical, Veterinary and Chiropractic X-ray Apparatus document.

3 – Owner details

Record, where known, the contact details of the owner of the apparatus including at least—

(a) the name of the owner; and
(b) the address of the owner; and
(c) the telephone number of the owner.

4 – Apparatus details

Record the details of the apparatus including at least—

(a) the make and model of the apparatus; and
  (i) the serial number—
  (ii) of the generator, where it is practical to do so; and
  (iii) of the X-ray tube, where it is practical to do so; and
  (iv) of the tube housing, where it is practical to do so; and
(b) the location of the apparatus (eg surgery 1, room 1).

5 – Accredited tester details

Record the details of the accredited tester including at least—

(a) the name of the accredited tester; and
(b) the accreditation number of the accredited tester; and
(c) the date on which the accredited tester performed the compliance tests.

6 – Test instrument details

Record for each test instrument used, at least—

(a) the make and model; and
(b) the serial number; and
(c) the date of the next calibration or the date of the last calibration.

7 – Floor Plan

(a) Make a floor plan of the area in which the apparatus is located. Note that it does not need to be to scale. The floor plan must indicate at least—
  (i) the location of the apparatus within the area; and
  (ii) the location of the vertical bucky, vertical chest stand, or similar (if installed); and
  (iii) the location of windows (if installed); and
  (iv) the location of doors and entrances used to directly access the area; and
  (v) the location of the apparatus control panel; and
  (vi) the location of the operator's protective screen (if applicable); and
  (vii) the location of the normal operator position; and
  (viii) the approximate dimensions of important features, including the immediate area in which the apparatus is located and the distance from the apparatus to the normal operating position.
(b) The floor plan, referred to in subsection (a), must be annotated such that it clearly identifies adjoining areas, including but not limited to hallways, reception areas, offices, staff rooms, storerooms, adjacent surgeries, external car parks, external walkways, and adjacent businesses.

Part 3 Shielding of fixed apparatus

8 – Control panel and operator protection

8.1 Test method

(a) Verify that the control panel is located—
  (i) in a room, space or enclosure adjacent to but separate from the area in which the apparatus is installed; or
  (ii) behind a fixed protective screen in the same room, space or enclosure in which the apparatus is installed.
(b) In the case of a control panel that is in a room, space, or enclosure adjacent to but separate from the area in which the apparatus is installed, verify that in accordance with a methodology from one of the approved guidelines set out in Schedule 1, the occupational exposure of a worker will not be greater than an effective dose of 5 millisieverts in a year.

For the purpose of shielding verification, the tester must:

  (i) specify the method used;
  (ii) provide evidence and details regarding assumptions used in calculations;
  (iii) specify phantom used in beam for scatter measurements;
  (iv) report kerma calculations behind barrier;

(c) In the case of a control panel that is behind a fixed protective screen in the same room, space or enclosure in which the apparatus is installed verify that—
  (i) the screen, where reasonably practicable, is arranged so that the radiation emitted by the apparatus is scattered at least twice before it can enter the area behind the screen; and
  (ii) in accordance with a methodology from one of the approved guidelines set out in Schedule 1, that the occupational exposure of a worker will not be greater than an effective dose of 5 millisieverts in a year.

For the purpose of shielding verification, the tester must:

(a) specify the method used;
(b) provide evidence and details regarding assumptions used in calculations;

(c) specify phantom used for scatter measurements;
(d) report kerma calculations behind barrier;

8.2 Legislative reference

Clause 4, *Code of Compliance for Facility Design and, Shielding 2022*

9 – Viewing the patient

9.1 Test method

Verify that the operator, from a position that complies with the requirements of section 8 is able to clearly observe the patient during the procedure—

(a) by means of closed-circuit television, mirror; or
(b) window that provides the required level of shielding.

9.2 Legislative reference

Clause 7, *Code of Compliance for facility design and shielding 2022.*

10 – Communicating with the patient

10.1 Test method

Verify that the operator, from a position that complies with the requirements of section 8, is able to communicate with the patient or any other person involved in the procedure.

10.2 Legislative reference

Clause 7, *Code of Compliance for facility design and shielding 2022.*

11 – Room, space, or enclosure to be fit for purpose †

11.1 Test method

Verify that the room, space or enclosure in which the apparatus is installed is of sufficient size to—

(a) allow the operator to position the X-ray tube; and
(b) allow the operator to position the patient for table, non-table or vertical bucky work; and
(c) allow other persons to be in the area as required; and
(d) allow the appropriate focus to skin distance to be used as a means of complying with the general duty of care.

11.2 Legislative reference

The general duty of care is applicable.

12 – General shielding of fixed apparatus

12.1 Test method

(a) Inspect the areas outside the room, space or enclosure in which the apparatus is located, including above ceiling and below floor, and identify the type of occupancy in each area in accordance with the method used. Clearly indicate the type of occupancy for each area identified in the test report and floor plan.
(b) In the case of an area occupied by a radiation worker only, verify that in accordance with a methodology from one of the approved guidelines set out in Schedule 1, the occupational exposure of a worker will not be greater than an effective dose of 5 millisieverts in one year.
(c) In the case of an area occupied by a member of the public, verify that in accordance with a methodology from one of the approved guidelines set out in Schedule 1, the exposure to a member of the public will not be greater than 1 millisievert in one year.
(d) In the case of an area that is not normally occupied, measurements are not required unless it can be reasonably anticipated the occupancy of the area will change—in which case verify compliance in accordance with subsections (b) and (c).

12.2 Legislative reference

Clause 4, *Code of Compliance for facility design and shielding 2022.*

13 – Dimensions of the fixed protective screen†

13.1 Test method

Verify that the protective screen, referred to in section 16, has a minimum height of 2 metres and a minimum width of 1 metre.

13.2 Legislative reference

The general duty of care is applicable.

Part 4 Shielding of mobile and portable apparatus

14 – Modified apparatus

If an apparatus designed to be mobile or portable is physically modified to an extent it can no longer be moved, or carried manually from place to place, the apparatus is to be regarded as fixed and compliance tested in accordance with Part 3.

15 – Mobile and portable apparatus primarily used in a single room, space or enclosure

(a) In the case of mobile or portable apparatus that is primarily used in a single room, space or enclosure, the apparatus must be compliance tested in accordance with sections 16 to 21.
(b) In the case of mobile or portable apparatus that is not primarily used in a single room, space or enclosure, the apparatus is considered true mobile or portable, and need not comply with the requirements of this protocol.

16 – Operator protection

16.1 Test method

(a) Whenever the X-ray tube is energised, verify that the normal operator's position is located—
    (i) outside the useful X-ray beam and at least 2 metres from the X-ray tube and from the patient; or
    (ii) in a room, space, or enclosure adjacent to but separate from the area in which the apparatus is located; or
    (iii) behind a protective screen in the same room, space or enclosure in which the apparatus is located.
(b) In the case of an operator's position located in a room, space or enclosure adjacent to but separate from the area in which the apparatus is installed, verify that in accordance with a methodology from one of the approved guidelines set out in Schedule 1, the occupational exposure of a worker will not be greater than an effective dose of 5 millisieverts in a year.
(c) In the case of an operator's position located behind a protective screen in the same room, space or enclosure in which the apparatus is located verify that—
    (i) the screen, where reasonably practicable, is arranged so that the radiation emitted by the apparatus is scattered at least twice before it can enter the area behind the screen; and
    (ii) in accordance with a methodology from one of the approved guidelines set out in Schedule 1, the occupational exposure of a worker will not be greater than an effective dose of 5 millisieverts in a year.

16.2 Legislative reference

Clauses 4 and 8, *Code of Compliance for facility design and shielding 2022.*

17 – Viewing the patient

17.1 Test method

Verify that the operator, from a position that complies with section 16, is able to observe the patient during the procedure by means of:

(a) closed-circuit television, mirror; or
(b) window that provides the required level of shielding.

17.2 Legislative reference

Clause 7, *Code of Compliance for facility design and shielding 2022.*

18 – Communicating with the patient

18.1 Test method

Verify that the operator, from a position that complies with section 16, is able to communicate with the patient.

18.2 Legislative reference

Clause 7, *Code of Compliance for facility design and shielding 2022.*

19 – Room, space or enclosure being fit for purpose†

19.1 Test method

Verify that the room, space or enclosure where the apparatus is primarily used, is of sufficient size to allow—

(a) the operator to position the X-ray tube; and
(b) the operator to position the patient for table, non-table or vertical bucky work; and
(c) other persons to be in the area as required; and
(d) the appropriate focus to skin distance to be used as a means of complying with the general duty of care.

19.2 Legislative reference

The general duty of care is applicable.

20 – General shielding of mobile and portable apparatus

20.1 Test method

In the case of a mobile or portable apparatus used primarily in a single room, space or enclosure, use the test method of section 12 to verify shielding to areas beyond barriers.

20.2 Legislative reference

Clause 4, *Code of Compliance for facility design and shielding 2022.*

21 – Dimensions of the protective screen†

21.1 Test method

Verify that the protective screen, referred to in section 16, has a minimum height of 2 metres and a minimum width of 1 metre.

21.2 Legislative reference

The general duty of care is applicable.

Part 5 Schedules

Schedule 1

22 – Approved guidelines

- National Council on Radiation Protection and Measurements, *Structural Shielding Design for Medical X-ray Imaging Facilities* (NCRP 147), 2004; or

- British Institute of Radiology (BIR), *Radiation Shielding for Diagnostic Radiology*, 2nd edition, Report of a BIR working party, October 2010 – April 2012

Document history

Publications

The first release of this document replaced *Test Protocol for shielding of medical, veterinary and chiropractic X-ray apparatus 2016*, which became obsolete on 11/02/2023

Title	Release	Commencement
Test Protocol for shielding of medical, veterinary and chiropractic X-ray apparatus 2023	first release	11.2.2023