Test Protocol for Shielding of Medical, Veterinary and Chiropractic X-ray Apparatus 2016

Published by the Environment Protection Authority of South Australia on 21 August 2017.

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, tomography, computed tomography, mammography, and soft tissue radiography, but excluding fluoroscopy using mini-C arm X-ray apparatus.

It should be read in conjunction with the Radiation Protection and Control Act 1982 (the Act) and the Radiation Protection and Control (Ionising Radiation) Regulations 2015 (the regulations).

Citation

This protocol may be cited as the Test Protocol for Shielding of Medical, Veterinary and Chiropractic X-ray Apparatus 2016.

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 33B 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 objective means the requirements under section 23 of the Act. Applicable sections are indicated by the symbol †;

grandfather clause means, in accordance with regulation 103(1)(a) of the regulations, apparatus must—if the apparatus was installed before 1 April 1986—comply with the regulations so indicated. Applicable sections are indicated by the symbol *

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, tomography, computed tomography, mammography, fluoroscopy, and soft tissue radiography, and 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—Exemptions applicable to this protocol

(1) The exemption notice pursuant to section 44 of the Act in the Government Gazette - 8 December 2011, page 4851—that exempts, subject to conditions, owners of medical, veterinary and chiropractic radiography X-ray apparatus from the requirements of regulation 104(8) of the Radiation Protection and Control (Ionising Radiation) Regulations 2000—has been applied to the test method of section 14.1.

(2) The exemption notice pursuant to section 44 of the Act in the Government Gazette - 28 March 2013, page 906—that exempts, subject to conditions, owners of apparatus used for mammography and soft tissue radiography from the requirements of regulation 104(9) of the Radiation Protection and Control (Ionising Radiation) Regulations 2000—has been applied to the test method of section 15.1.

3—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 4 to 8; and

(ii) the test parameters used and results obtained for the compliance tests performed under Part 3 and Part 4; and

(c) complete the approved Certificate of Compliance for Shielding of Medical, Veterinary and Chiropractic X-ray Apparatus document.

4—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.

5—Apparatus details

Record the details of the apparatus including at least—

(a) the make and model of the apparatus; and

(b) the serial number—

(i) of the generator, where it is practical to do so; and

(ii) the serial number of the X-ray tube, where it is practical to do so; and

(iii) the serial number of the tube housing, where it is practical to do so; and

(c) the location of the apparatus (e.g. surgery 1, room 1).
6—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.

7—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.

8—Floor Plan

(1) 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—

(a) the location of the apparatus within the area; and
(b) the location of the vertical bucky, vertical chest stand, or similar (if installed); and
(c) the location of windows (if installed); and
(d) the location of doors and entrances used to directly access the area; and
(e) the location of the apparatus control panel; and
(f) the location of the operator’s protective screen (if applicable); and
(g) the location of the normal operator position; and
(h) 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.

(2) The floor plan, referred to in subsection (1), must be annotated such that it clearly identifies adjoining areas, including but not limited to—hallways, reception areas, offices, staff rooms, store rooms, adjacent surgeries, external car parks, external walk ways, and adjacent businesses.

Part 3—Shielding of fixed apparatus

9—Control panel and operator protection*

9.1 Test method

(1) Verify that the control panel is located—

(a) in a room, space or enclosure adjacent to but separate from the area in which the apparatus is installed; or
(b) behind a fixed protective screen in the same room, space or enclosure in which the apparatus is installed.

(2) 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, in accordance with the methodology specified in Schedule 1, that the equivalent dose rate does not exceed 25 microsieverts per hour.

(3) In the case of a control panel that is behind an fixed protective screen in the same room, space or enclosure in which the apparatus is installed verify that—

(a) 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
(b) verify, in accordance with methodology specified in Schedule 1—
(i) that approximately 50 millimetres from behind the screen the equivalent dose rate does not exceed 25 microsieverts per hour; and
(ii) from the operator position at the control panel, no part of the operator can be exposed to radiation that exceeds 25 microsieverts per hour.

9.2 Legislative reference
Regulation 103(2) of the regulations. This regulation is subject to the grandfather clause.

10—Viewing the patient*

10.1 Test method
Verify that the operator, from a position that complies with the requirements of section 9, is able to see the patient—
(a) by means of closed circuit television or a mirror; or
(b) through a viewing window that complies with the requirements of section 14.

10.2 Legislative reference
Regulation 103(3) of the regulations. This regulation is subject to the grandfather clause.

11—Communicating with the patient*

11.1 Test method
Verify that the operator, from a position that complies with the requirements of section 9, is able to communicate with the patient.

11.2 Legislative reference
Regulation 103(4) of the regulations. This regulation is subject to the grandfather clause.

12—Room, space or enclosure to be fit for purpose*

12.1 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 objective.

12.2 Legislative reference
Regulation 103(5) of the regulations. This regulation is subject to the grandfather clause.

13—General shielding of fixed apparatus

13.1 Test method
(1) Inspect the areas outside the room, space or enclosure in which the apparatus is located and identify the type of occupancy in accordance with areas that are—
(a) continuously occupied by a radiation worker, other than the operator of the apparatus, or a member of the public for a short time only; or
(b) occupied by a member of the public for other than a short period of time; or
(c) not normally occupied, and
in the test report clearly indicate the type of occupancy for each area identified.
(2) In the case of an area continuously occupied by a radiation worker or an area (i.e. a corridor, walkway, lift, stairway, car park, toilet or other area) occupied by a member of the public for a short time, verify, in accordance with the methodology specified in Schedule 1, that the equivalent dose rate does not exceed 25 microsieverts per hour.

(3) In the case of an area occupied by a member of the public for other than a short period of time, verify, in accordance with the methodology specified in Schedule 1, that the equivalent dose rate does not exceed 2.5 microsieverts per hour.

(4) 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 (2) and (3).

13.2 Legislative reference
Regulations 103(6) and 103(7) of the regulations.

14—Viewing window

14.1 Test method
Verify that the viewing window referred to in section 10 is at least 300 millimetres by 400 millimetres.

14.2 Legislative reference
(1) Regulation 103(8) of the regulations is applicable.
(2) The exemption referred to section 2(1) has been applied to the test method of section 14.1.

15—Dimensions of the fixed protective screen

15.1 Test method
Verify that the fixed protective screen referred to in section 9 is—

(a) in the case of apparatus used for mammography, not more than 150 millimetres from the floor and not less than 1850 millimetres in height and a minimum width of 600 millimetres; or
(b) in all other cases, has a minimum height of 2 metres and a minimum width of 1 metre.

15.2 Legislative reference
(1) Regulation 103(9) of the regulations is applicable.
(2) The exemption referred to in section 2(2) has been applied to the test method of section 15.1.

Part 4—Shielding of mobile and portable apparatus

16—Modified apparatus
If an apparatus is designed to be mobile or portable but has been physically modified to an extent that it can no longer be moved from place to place, in the case of a mobile apparatus, or carried manually from place to place, in the case of a portable apparatus, the apparatus is to be regarded as fixed and compliance tested in accordance with Part 3.

17—Mobile and portable apparatus primarily used in a single room, space or enclosure
(1) 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 18 to 23.
(2) In the case of mobile or portable apparatus that is not primarily used in a single room, space or enclosure, the apparatus is true mobile or portable and need not comply with the requirements of this protocol.
18—Operator protection†

18.1 Test method

(1) Whenever the X-ray tube is energised, verify that the normal operator’s position is located—
   (a) outside the useful X-ray beam and at least 2 metres from the X-ray tube and from the patient; or
   (b) in a room, space or enclosure adjacent to but separate from the area in which the apparatus is located; or
   (c) behind a protective screen in the same room, space or enclosure in which the apparatus is located.

(2) 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, in accordance with the methodology specified in Schedule 1, that the equivalent dose rate does not exceed 25 microsieverts per hour.

(3) 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—
   (a) 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
   (b) verify, in accordance with methodology specified in Schedule 1—
       (i) that approximately 50 millimetres from behind the screen the equivalent dose rate does not exceed 25 microsieverts per hour; and
       (ii) from the operator position at the control panel, no part of the operator can be exposed to radiation that exceeds 25 microsieverts per hour.

18.2 Legislative reference

The general objective is applicable.

19—Viewing the patient†

19.1 Test method

Verify that the operator, from a position that complies with section 18, is able to see the patient by some means.

19.2 Legislative reference

The general objective is applicable.

20—Communicating with the patient†

20.1 Test method

Verify that the operator, from a position that complies with section 18, is able to communicate with the patient.

20.2 Legislative reference

The general objective is applicable.

21—Room, space or enclosure being fit for purpose†

21.1 Test method

Verify that the room, space or enclosure where the apparatus is primarily used, 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 objective.
21.2 Legislative reference
The general objective is applicable.

22—General shielding of mobile and portable apparatus†

22.1 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 13.1 with the exception that the floor and ceiling in which the apparatus is located do not have to comply with the requirements of section of 13.

22.2 Legislative reference
The general objective is applicable.

23—Dimensions of the protective screen†

23.1 Test method
Verify that the protective screen, referred to in section 18, has a minimum height of 2 metres and a minimum width of 1 metre.

23.2 Legislative reference
The general objective is applicable.
Part 5—Schedules

Schedule 1—Methodology

24—Test Method

Verifying compliance must be performed in accordance with the requirements of this schedule.

25—Phantom configuration

Place a phantom in the primary beam that—

(a) in the case of plain X-ray apparatus, computed tomography X-ray apparatus, or a fluoroscopy X-ray apparatus, consists of a Perspex phantom, water phantom, or similar that is of sufficient thickness to simulate an adult chest or abdomen exposure; and

(b) in the case of mammography X-ray apparatus consists of a Perspex block or blocks that are a total of 6 centimetres in thickness and a width and depth sufficient to cover the breast plate of the apparatus.

26—Configuring the apparatus

Configure the apparatus to operate at—

(a) the maximum rated (i.e. available) X-ray tube potential; and

(b) an X-ray tube current and exposure time (or the product of the X-ray tube current and exposure time) that is at least sufficient to produce a measurable dose rate above background radiation; and

(c) a beam size (i.e. collimator size) appropriate to the phantom used; and

(d) in the case of an X-ray tube with more than one focal spot, the broadest focus available.

27—Determine the maximum continuous tube current

Determine the maximum continuous tube current when the apparatus is operated at its maximum rated (i.e. available) X-ray tube potential, from a value provided by the manufacturer of the apparatus or derived from manufacturer’s data.

28—Measuring dose rate

(1) Measure the dose rate 50 millimetres from any wall, door, window, floor or ceiling outside a room, space or enclosure in which the apparatus is located—

(a) at various measurement points, where it is reasonable and practical to do so (refer to Figure 1 for examples), including at heights up to the ceiling height and 50 millimetres from the ceiling; and

(b) in the case of barriers behind vertical bucky units or similar, perform measurements using the primary beam as a measurement source.

(2) As desired, correct each measured dose rate, referred to in subsection (1) for—

(a) background radiation; and

(b) measurement tolerances and uncertainties.
Figure 1 – Examples of measurement point locations

29—Calculating the equivalent dose rate

(1) As required, scale the measured dose rate by multiplying it by the quotient of the maximum beam size available (length or area) with the beam size referred to in section 26(c).

(2) Calculate the equivalent dose rate in microsieverts per hour using the following formulae or its equivalent—

\[
\left( \frac{\text{maximum continuous tube current}}{\text{set tube current}} \right) \times \text{measured dose rate} \times \text{weighting factor} \quad [\mu\text{Sv/h}]
\]

Where the weighting factor has a value of -

(a) one half (0.5) in the case of -
   (i) an area continuously occupied by a radiation worker; or
   (ii) a corridor, walkway, lift, stairway, carpark, toilet or other area that is occupied by a member of the public for a short time; or

(b) one tenth (0.1) in the case of an area occupied by a member of the public for other than a short period of time.

30—Verifying compliance

(1) In the case of a radiation worker continually occupying an area or a member of the public occupying an area for a short time, verify that the equivalent dose rate, referred to in section 29, does not exceed 25 microsieverts per hour.

(2) In the case of a member of the public occupying an area for other than a short period of time, verify that the equivalent dose rate, referred to in section 29, does not exceed 2.5 microsieverts per hour.
Document history

Publications

The first release of this document replaced *EPA Protocols: Shielding verification of premises containing medical, veterinary or chiropractic X-ray apparatus, Doc. No. RP104A*, which became obsolete on 5.2.2016.

<table>
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Amendments

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Section 28

figure 1 added 21.8.2017

Section 28(1)

dose deleted 21.8.2017
dose rate added 21.8.2017
where it reasonable and practical to do so added 21.8.2017
reference to height added 21.8.2017

Section 28(2)

dose deleted 21.8.2017
measured dose rate added 21.8.2017

Section 29

subsections (1) to (5) deleted 21.8.2017
subsections (1) and (2) added 21.8.2017
maximum beam size reference and new equivalent dose rate formula included

Section 30(1)
equivalent dose rate in μSv/h deleted 21.8.2017
equivalent dose rate added 21.8.2017
reference to section 29(2) deleted 21.8.2017
reference to section 29 added 21.8.2017

Section 30(2)
equivalent dose rate in μSv/h deleted 21.8.2017
equivalent dose rate added 21.8.2017
reference to section 29(2) deleted 21.8.2017
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Schedule 2 deleted 21.8.2017