Test Protocol for medical and veterinary fluoroscopy X-ray apparatus 2023

Issued February 2023

This protocol provides the mandatory requirements for an accredited tester performing compliance testing of fluoroscopy X-ray apparatus under the following scenarios:

- when the apparatus is first installed;
- at a frequency as set out in the Code of Compliance for medical, veterinary and chiropractic X-ray apparatus 2022 published by the Department (applicable when the apparatus is used on humans only);
- after any major repair or replacement that could affect radiation safety.

It should be read in conjunction with the —

- *Radiation Protection and Control Act 2021* (RPC Act);
- *Radiation Protection and Control Regulations 2022* (RPC Regulations);
- *Code of Compliance for medical, veterinary and chiropractic X-ray apparatus 2022* published by the Department;
- *Code of Compliance for labelling and signage of ionising radiation sources 2022* published by the Department;
- *Code of Compliance for facility design and shielding 2022* published by the Department.

Citation

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

Part 1 Interpretation

In this protocol, unless the contrary intention appears—

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;

AERC means automatic exposure rate control. Also known as automatic brightness control (ABC) for image intensifiers;

air kerma means kerma measured in mass of air;

aperture means a gap in the protective material of a *tube housing* through which ionising radiation from an *X-ray tube* within the *tube housing* may pass with little or no attenuation;

apparatus means ionising radiation apparatus;

Department means the administrative unit of the South Australian Public Service that is responsible for assisting the Minister in the administration of the Act;

DSA means Digital Subtraction Angiography;

EPA means the Environment Protection Authority, South Australia;

equivalent dose means the absorbed dose delivered by a type of radiation averaged over a tissue or organ multiplied by the radiation weighting factor for the radiation type;

fixed, in relation to *apparatus*, means any *apparatus* that is neither a *mobile apparatus* nor a *portable apparatus*;

image receptor means an image intensifier or flat panel digital detector;

KAP means air kerma-area product means air kerma multiplied by radiation area. The KAP value may be displayed on the operator's console, or on a separate kerma-area product meter. The units of KAP are typically $Gy.cm^2$, or similar, eg $mGy.cm^2$, $cGy.cm^2$, $\mu Gy.m^2$. It is important to make a note of the unit when conducting a patient dosimetry audit;

kerma means kinetic energy released per unit mass; it is a measure of the sum of the initial kinetic energies of all charged particles liberated by uncharged radiation, such as photons and neutrons, per unit mass of material. Unit: J/kg or gray (Gy);

mobile, in relation to *apparatus,* means *apparatus* that is designed and constructed so as to be moveable from place to place for use as required but does not include a *portable apparatus*;

plain radiography means the technique for obtaining, recording and processing directly or after transfer, static information contained in an X-ray image at an image receptor where the *X-ray tube* is stationary throughout the exposure;

portable, in relation to *apparatus,* means any *apparatus* that is designed to be carried manually from place to place for use as required;

primary beam means that part of the X-radiation that passes through an *aperture* of a *tube housing* by a direct path from an *X-ray tube*;

SID means source-to-image receptor distance;

X-ray tube housing, in relation to an *apparatus*, means a container in which an *X-ray tube* is mounted for normal use, providing protection against electric shock and against ionising radiation except for an *aperture* for the useful beam;

X-ray tube, in relation to an *apparatus*, means an evacuated envelope in which electrons are accelerated for the purposes of the production of ionising radiation.

Part 2 General requirements

1 – Application of protocol

This protocol applies to *fixed* and *mobile apparatus* used for medical and veterinary fluoroscopy, including *apparatus* capable of both fluoroscopy and *plain radiography*.

2 – Complying with this protocol

The accredited tester must—

(a) perform compliance testing in accordance with the test methods specified in Part 3; and

(b) provide in a report—

(i) the details as specified in sections 3 to 6; and

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

(iii) complete the approved *Certificate of Compliance for Medical and Veterinary Fluoroscopy X-ray Apparatus* document.

(c) In the event of a critical failure of a test, the accredited tester must immediately inform the owner, or responsible person, of the failure of that test and the owner's obligation to immediately inform the EPA.

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

(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* (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.

Part 3 Testing requirements for fixed and mobile fluoroscopy apparatus when used in fluoroscopy mode and plain radiography mode

7 – Labelling of generators and tube assemblies

7.1 Test method

Verify that the apparatus has a label—

(a) X-ray generators and tube assemblies must be permanently marked in English and the markings must be readily available by means of labels on the apparatus. For infection control reasons, it is acceptable for the labels to be hidden behind a panel, but it must be possible to access these labels.

(b) X-ray generator markings must bear—

(i) the name or trademark of the manufacturer;

(ii) model name or number; and

(iii) the serial number.

(c) X-ray tube assemblies must bear—

(i) the name or trademark of the manufacturer of the X-ray tube housing and insert;

(ii) the type or model number and serial number of the X-ray tube housing and insert; and

(iii) the position of the focal spot(s). For dual focus X-ray tubes, a single indication of mean focal spot position is permissible.

7.2 Legislative reference

Schedule 3, test 1, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022.*

8 – Labelling of apparatus

8.1 Test method

Verify that the apparatus has a label—

(a) that complies with the requirements of *AS 1319–1994 Safety Signs for the Occupational Environment* applying to warning signs; and

(b) bears the words 'RADIATION PRODUCED WHEN ENERGISED' or words to that effect; and

(c) bears the radiation symbol as specified in Schedule 1; and

(d) is clearly legible at a distance of 2 metres.

8.2 Legislative reference

Clause 4, *Code of Compliance for labelling and signage of ionising radiation sources 2022*.

9 – Radiation area sign

9.1 Test method

(a) Verify that a sign is clearly displayed, at each entrance, walkway or access route to the room or area in which the *apparatus* is located—other than an entrance to the room from a place or another room which can only be entered from the room.

(b) Verify that the sign—

(i) complies with the requirements *of AS 1319–1994 Safety Signs for the Occupational Environment* applying to warning signs; and

(ii) bears words 'Caution X-rays in use – authorised entry only' (or equivalent) must be displayed at each entry point to the room;

(iii) bears the radiation symbol as specified in Schedule 1; and

(iv) in the case of fixed apparatus, an illuminated radiation warning sign, displaying the words 'Ionising radiation – do not enter' (or equivalent) must be positioned directly adjacent to any entry point of the room. These signs must illuminate immediately upon exposure and continue to illuminate during exposure.

9.2 Legislative reference

Clause 5, *Code of Compliance for labelling and signage of ionising radiation sources 2022*.

10 – Apparatus to be in good working order

10.1 Test method

Verify that there is no abnormality, fault, or condition, that is not subject to another section of this protocol, that prevents the apparatus from functioning or performing in a manner for which it has been designed.

10.2 Legislative reference

Regulation 80(2), RPC Regulations.

11 – Mains switch

11.1 Test method

Verify that the apparatus has a mains switch—

(a) that is readily accessible, clearly identifies ‘ON’ and ‘OFF’ positions; and

(b) has a mains indicator light to indicate when the control panel is energised and the mains switch is in the ‘ON’ position.

11.2 Legislative reference

Schedule 3, test 3, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

12 – Warning device during fluoroscopy

12.1 Test method

Verify that the apparatus has incorporated into it a device that provides a warning to the operator whenever the X-ray tube is energised and that warning consists of—

(a) clearly distinguishable light; and

(b) a signalling device audible at the operator position that indicates the duration or termination of exposure.

12.2 Legislative reference

Schedule 3, tests 4 & 7, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

13 – Automatic Mode (AEC)

13.1 Test method

Verify that apparatus operating with automatic exposure control (AEC) systems, the preselected mode of operation is indicated on the control panel.

13.2 Legislative reference

Schedule 3, test 5, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

14 – Exposure factors during fluoroscopy

14.1 Test method

Verify that the apparatus is fitted with visual indicators on the control panel that provide a continuous indication of:

(a) X-ray tube potential; and

(b) X-ray tube current and or product of X-ray tube current and time; and

(c) frame rate and magnification.

For permanently fixed exposure factors, verify these factors are indicated on the control panel.

14.2 Legislative reference

Schedule 3, test 6, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

15 – Multiple X-ray tubes

15.1 Test method

Except in the case of apparatus specifically designed for two tube techniques, verify that if more than one X-ray tube can be operated from a single control panel—

(a) it is not possible to energise more than one X-ray tube at the same time; and

(b) there is an indication on the control panel showing which X-ray tube is selected; and

(c) in the case of fluoroscopy apparatus with under table and associated over table X-ray tubes there is an indication, at or near each tube housing showing which X-ray tube is selected.

15.2 Legislative reference

Schedule 3, test 8, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

16 – Exposure switch

16.1 Test method

Verify that—

(a) continuous pressure must be maintained on the exposure switch in order to maintain radiation exposure and may be interrupted at any time; and

(b) after a radiation exposure has terminated, another exposure is not possible without releasing the exposure switch; and

(c) in the case of programmed exposures, there is a means of interrupting the programme; and

(d) in the case of mobile apparatus, control of the exposure switch is operable from greater than 2 metres away from the X-ray tube; and

(e) in the case of a foot operated exposure switch, it is protected from accidental operation by a cover on the switch.

16.2 Legislative reference

Schedule 3, test 9, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

17 – Protection of operator at the table side

17.1 Test method

In the case of a fixed under table fluoroscopic X-ray tube and adjacent operator controls, verify that the apparatus has drapes that—

(a) have a lead equivalent of no less than 0.5 millimetres at 150 kVp; and

(b) have a minimum width of 450 mm; and

(c) are designed to attach to the lower edge of the image receptor carriage; and

(d) consist of overlapping sheets; and

(e) are attached to the image receptor carriage in such a way that there is no gap between the drapes and the image receptor carriage; and

(f) reach the tabletop when the image receptor carriage is in its maximum vertical position; and

(g) are adjustable to protect the operator of the apparatus when the table is in the tilted position; and

(h) for a fluoroscopic unit designed for radiography, verify there is a shielded bucky slot cover that provides the equivalent protection of 0.5 mm of lead at 100 kVp.

17.2 Legislative reference

Schedule 3, test 10, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

18 – Fluoroscopy units with over-table X-ray tube

18.1 Test method

Verify that the apparatus—

(a) has a collimator with a light beam device; and

(b) where the direct radiography mode is not disabled, the perimeter of the light field and X-ray field must coincide to within ±1% of the distance from focal spot to image receptor; and

(c) has an exposure switch for radiographic exposures that is located at the control panel and not at the table unless shielding is provided for the operator.

18.2 Legislative reference

Schedule 3, test 11, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

19 – Stability of X-ray tube assembly

19.1 Test method

Verify that for each position, the X-ray tube assembly does not move and remains stationary during exposure.

19.2 Legislative reference

Schedule 3, test 12, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

20 – Stability of mobile apparatus

20.1 Test method

Verify that—

(a) the apparatus does not move once in position for exposure; and

(b) the apparatus is effectively balanced or positively locked to remain stable when the C-arm is in any position.

20.2 Legislative reference

Schedule 3, test 13, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

21 – Tube voltage accuracy

21.1 Test method

Verify that—

(a) where tube voltage (kVp) is manually selectable, the measured kVp is within ±5% or 5 kVp (whichever is greater) of the set kVp across the range available; and

(b) in the case of multiple X-ray tubes, kVp accuracy for all X-ray tubes is compliant with limits stated above.

Critical failure: ≥ ±10% or ≥ ±10 kVp whichever is the greater.

21.2 Legislative reference

Schedule 3, test 14, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

22 – Radiographic timer accuracy

22.1 Test method

Verify that measured exposure times across a clinical range—

(a) are within ± 10% of the indicated value for exposure times ≥100 ms; or

(b) within ± 20% ±1 pulse of the indicated value for exposure times less ≤100 ms

Critical failure: ≥ ±20% (for times ≥100 ms) or ≥ ±30 kVp (for time <100 ms).

22.2 Legislative reference

Schedule 3, test 15, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

23 – Radiographic radiation output reproducibility

23.1 Test method

Verify that the apparatus produces a consistent radiation output—

(a) by making at least five measurements of radiation output performed at the same X-ray tube potential, X-ray tube current, and exposure time; and

(b) by calculating the coefficient of variation of at least five measurements; and

(c) by verifying that the calculated coefficient of variation is less than or equal to 0.05.

Critical failure: coefficient of variation ≥0.1.

23.2 Legislative reference

Schedule 3, test 16, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

24 – Fluoroscopy radiation output reproducibility

24.1 Test method

Verify that the air kerma from 5 consecutive measures at 80 kVp are within ±10% of the mean.

Critical failure: ≥ ±20%.

24.2 Legislative reference

Schedule 3, test 17, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

25 – Accuracy of kerma area product (KAP)

25.1 Test method

Verify that for at least 5 measures of KAP at clinically relevant exposure setting and using a patient equivalent phantom of PMMA blocks—

(a) measured KAP is within ±20%of the displayed KAP; and

(b) where using AEC, lead or another suitable attenuator may be used to cover the image receptor to drive up the kVp and mA;

Critical failure: ≥±35%.

25.2 Legislative reference

Schedule 3, test 18, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

26 – Fluoroscopic timing device

26.1 Test method

Verify that—

(a) the apparatus is fitted with a cumulative timing device that is activated when the X-ray tube is activated for fluoroscopy and gives an indication of the total screening time; and

(b) after a pre-set exposure time not exceeding 5 minutes, and at least 30 seconds before automatic termination, a continuous audible signal is given to enable resetting of the device.

26.2 Legislative reference

Schedule 3, test 19, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

27 – Radiation beam quality

27.1 Test method

(a) for a range of clinically relevant set X-ray tube potentials, measure the half value layer of the primary beam.

(b) verify that the measured half value layer, for the selected tube potential, is not less than value specified in the table below.

Indicated X-ray tube potential (kVp)	Minimum HVL (mm Al) for apparatus manufactured before 2015	Minimum HVL (mm Al) for apparatus manufactured on or after 2015
50	1.5	1.8
60	1.8	2.2
70	2.1	2.5

Indicated X-ray tube potential (kVp)	Minimum HVL (mm Al) for apparatus manufactured before 2015	Minimum HVL (mm Al) for apparatus manufactured on or after 2015
80	2.3	2.9
90	2.5	3.2
100	2.7	3.6
110	3.0	3.9
120	3.2	4.3
130	3.5	4.7
140	3.8	5.0
150	4.1	5.4

Critical failure: if filtration does not meet the values in the table above.

27.2 Legislative reference

Schedule 3, test 20, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

28 – Last image hold

28.1 Test method

Verify that the apparatus is capable of retaining the last image on the viewing monitor.

Critical failure: no last image hold

28.2 Legislative reference

Schedule 3, test 21, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

29 – Focus to skin distance (FSD)

29.1 Test method

Verify that—

(a) for fixed apparatus, where the patient support is permanently between the X-ray tube and image receptor, FSD is not less than 400 mm; and

(b) in the case of any other fixed apparatus, FSD is not less than 300 mm; and

(c) in the case of mobile apparatus, FSD is not less than 200 mm.

Critical failure: FSD <200 mm

The above FSD requirements are not applicable for mini C-arm apparatus with maximum X-ray tube current not exceeding 200 microamperes.

29.2 Legislative reference

Schedule 3, test 22, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

30 – Beam alignment and collimation

30.1 Test method

Verify that—

(a) the apparatus is interlocked so that the fluoroscopic X-ray tube is not operable whenever the image receptor is taken out of the path of the primary beam; and

(b) the primary beam is centred to the image receptor and appears as the centre of image on the monitor; and

(c) no part of the primary beam falls outside the image receptor; and

(d) it is not possible to override the beam-limiting operation to give a larger field; and

(e) the beam-limiting device limits the area of the primary beam such that the ratio of the radiation field area and imaged field area is ≤1.15; and

(f) the beam limiting device allows collimation to the area of clinical interest; and

(g) the selected nominal field size must not differ from the imaged field size by more than ±10%.

Critical failure: Radiation area >1.25 x image area.

30.2 Test requirements

Repeat measurements of radiation field and imaged field areas for each nominal field size at maximum and minimum SID.

30.3 Measurement conditions

Note: this example uses a CR cassette. Other means to measure radiation field area may be substituted.

(a) Ensure collimators are fully open.

(b) Place CR cassette as close as possible to image receptor surface.

(c) Expose cassette under AERC or low kVp for 1–2 seconds.

(d) Record the imaged field shape and measure the dimensions (see below) Note: a magnification correction is required for the distance between the image receptor and the CR cassette.

(e) Calculate the radiation field area (see below).

(f) Place a test object of known dimensions (ideally with graduated markings) on the image receptor surface and expose under AERC or low kVp for 1–2 seconds.

(g) Record the shape of the imaged field and the dimensions of image and test object on the monitor. Use the ratio of the test object length and the measure of test object length from the display image to calculate the imaged field dimensions. Note: a magnification correction is required for the distance between the image receptor and test object.

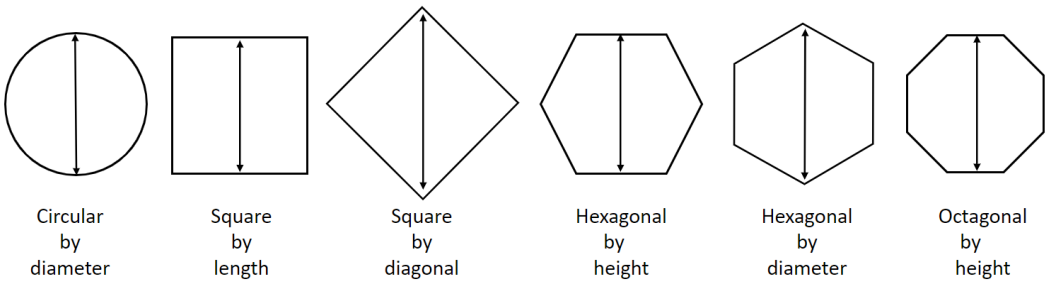
(h) Calculate the imaged field area (see below).

(i) Compare the radiation field area to the imaged field area for all selected field sizes.

(j) Compare the imaged field dimensions to the nominal field dimensions.

(k) Confirm that the radiation field lies within the image receptor including the receptor housing.

Dimensions of the radiation and imaged fields should be measured as illustrated below.



Radiation and imaged field areas should be calculated for the specific field shape by:

Dimension^2 x shape-specific constant (see table below)

Field shape	Constant
Circular (by diameter)	0.785
Square (by length)	1.000
Square (by diagonal)	0.500
Hexagonal (by height)	0.866
Hexagonal (by diameter)	0.650
Octagonal (by height)	0.828

30.4 Legislative reference

Schedule 3, test 23, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022.*

31 – Exposure limit during fluoroscopy

31.1 Test method

(a) Measure the air kerma rate at the maximum X-ray tube potential and current settings in scatter free conditions using the detector position described for the apparatus type in the table below—

Fluoroscopy unit construction	Detector positioning
X-ray tube mounted permanently under table	On the table
X-ray tube mounted permanently over table	300 mm above the table
C or U-arm systems with image receptor mechanically linked; with or without permanent patient support	300 mm from the image receptor surface but not less than 400 mm from the focal spot
C-arm systems specifically for extremity use (FSD ≤ 450 mm) X-ray tube and image receptor mechanically linked.	At minimum focus to skin distance
Other fluoroscopic systems with no permanent patient support	400 mm from focal spot

(b) Verify that the measured air kerma rates do not exceed the limits specified in the table below for the specified control type.

Control type	Air kerma rate limit (milligray per minute)	Critical dose rate failure limit (milligray per minute)
Manual	50	≥100
Normal	100	≥150
High level (boost)	150	≥225

31.2 Legislative reference

Schedule 3, test 24, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

32 – Exposure limit during image acquisition

32.1 Test method

For the modes of acquisition below, verify that the air kerma rate per frame, at 300 mm from image receptor, does not exceed the values in the table below—

Mode	Air kerma rate limit (milligray per frame)	Critical air kerma rate failure limit (milligray per frame)
DSA	2.0	≥ 2.0
Cardiac	0.2	≥ 0.2

32.2 Legislative reference

Schedule 3, test 25, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

33 – High level boost during fluoroscopy (excludes DSA)

Any mode in which the maximum incident air kerma rate exceeds values applicable to normal mode is classified as high level (boost) mode.

33.1 Test method

If the apparatus is fitted with a high level control, verify that the control—

(a) requires continuous activation by the operator of the apparatus for its operation; and

(b) has a continuous audible signal, distinguishable from that used for normal fluoroscopy, to indicate that the high level control is being employed; and

(c) be restricted to a maximum of 20 seconds after which the system returns to normal fluoroscopic dose rate; and

(d) can only be accessed through the automatic mode of operation; and

(e) will revert to normal dose rate setting if not used within 5 minutes or power to the apparatus is interrupted.

33.2 Legislative reference

Schedule 3, test 26, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

34 – Air kerma rate at surface of image receptor during fluoroscopy

34.1 Test method

Verify that the air kerma rate at the input surface of the image detector does not exceed the rate for the corresponding field size in the table below.

Field size (cm)	Entrance air kerma rate (µGy/min) AERC	Critical failure limit; entrance air kerma (µGy/min) under AERC
11 to 14	≤120	>120
≥14 to 23	≤80	>80
>23	≤60	>60

Measurement conditions:

(a) for automatic brightness/dose rate systems, sufficient copper filtration is to be added to the X-ray beam to obtain an X-ray tube voltage between 70 kVp and 80 kVp; or

(b) for manual systems, where radiation levels should not be exceeded for normal clinical settings when used with average patients; and

(c) measurements should be obtained without the grid or alternatively, by applying a traceable grid correction factor for the energy of the X-ray beam used.

34.2 Legislative reference

Schedule 3, test 27, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

35 – Air kerma rate at surface of image receptor during DSA

35.1 Test method

Verify that the air kerma rate at input surface of the image receptor during DSA does not exceed the values for the frame rates given in the table below—

Frame rate	Maximum air kerma rate during DSA	Critical failure limit; maximum air kerma rate during DSA
≤10 frames/s	10 µGy/frame	>10 µGy/frame
>10 frames/s	1 µGy/frame	>1 µGy/frame

35.2 Legislative reference

Schedule 3, test 28, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

36 – Air kerma rate at surface of image receptor during cinefluorography

36.1 Test method

Verify that the air kerma rate at input surface of the image receptor during cinefluorography does not exceed the values for the frame rates given in the table below—

Frame size	Maximum air kerma rate during cinefluorography	Critical failure limit; maximum air kerma rate during DSA
<17 cm	0.2 µGy/frame	>0.2 µGy/frame
≥17 cm	0.1 µGy/frame	>0.1 µGy/frame

36.2 Legislative reference

Schedule 3, test 29, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

37 – High-contrast resolution of live image

37.1 Test method

Verify that the high contrast resolution of live images is not less than the values specified for the field sizes in the table overleaf.

Apparatus	Field size (cm)	Resolution (lp/mm)
Apparatus manufactured from 2015 onwards	<18	1.8
	18 to <26	1.6
	26 to <30	1.4
	30 to 36	1.2
	>36	1.0
Apparatus manufactured before 2015	≤25	1.2
	>25	1.0

Critical failure: <0.8 lp/mm for field sizes >25 cm
<1.0 lp/mm for field sizes ≤25 cm

Measurement conditions:

(a) Measures to be made with clinically relevant AEC exposure settings.

(b) SID should be minimum

(c) Line pair phantom must be in the centre of image receptor

(d) Manufacturer's instructions should be followed while using test object

(e) Exposures should be made at clinically relevant AEC exposure settings.

(f) Line pairs visible should be evaluated on the clinical reference monitor

37.2 Legislative reference

Schedule 3, test 30, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

38 – Low-contrast resolution and low contrast threshold of live image

38.1 Test method

Verify that the low contrast resolution of the live image, using a Westmead test object (or equivalent), on the clinical reference monitor, is not less that the values in table below—

Apparatus type	Minimum resolution
General	1.5 mm (6 circles on Westmead phantom)
High dose rate	1.0 mm (7 circles on Westmead phantom)

The low contrast resolution of the live image must not exceed 4% (minimum 10 large circles on Westmead phantom). Any significant distortion must be noted on the compliance test report.

Critical failure: Low contrast threshold >4%

Measurement conditions:

(a) Test object must be place at centre of image receptor.

(b) SID should be set to normal operating distance or at 100 cm.

(c) Measurements should be made at clinically relevant settings and live image evaluated on clinical reference monitor.

38.2 Legislative reference

Schedule 3, test 31, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

39 – Radiation leakage from the X-ray tube housing

39.1 Test method

Verify that radiation leakage at 1 metre from the focus of the X-ray tube and from the beam limiting device, measured at orthogonal points around the tube housing does not exceed 1 mGy in 1 hour.

Critical failure: failure to meet above requirements.

Measurement conditions:

(a) Cover the collimator aperture with lead of sufficient thickness to ensure that the primary beam contribution to measurements is negligible

(b) AEC is set to maximum kVp and maximum mA ensuring that the tube rating is not exceeded.

(c) Use the inverse square law correction to calculate exposure rates at 1 m from focal spot.

(d) The exposure rate is scaled to a value corresponding to one that has been measured in 1 hour.

(e) Calculate time averaged leakage using manufacturer recommended continuous mA rating at the kVp used for the measurement or using the tube cooling curve data.

Critical failure: 1.5 mGy/h

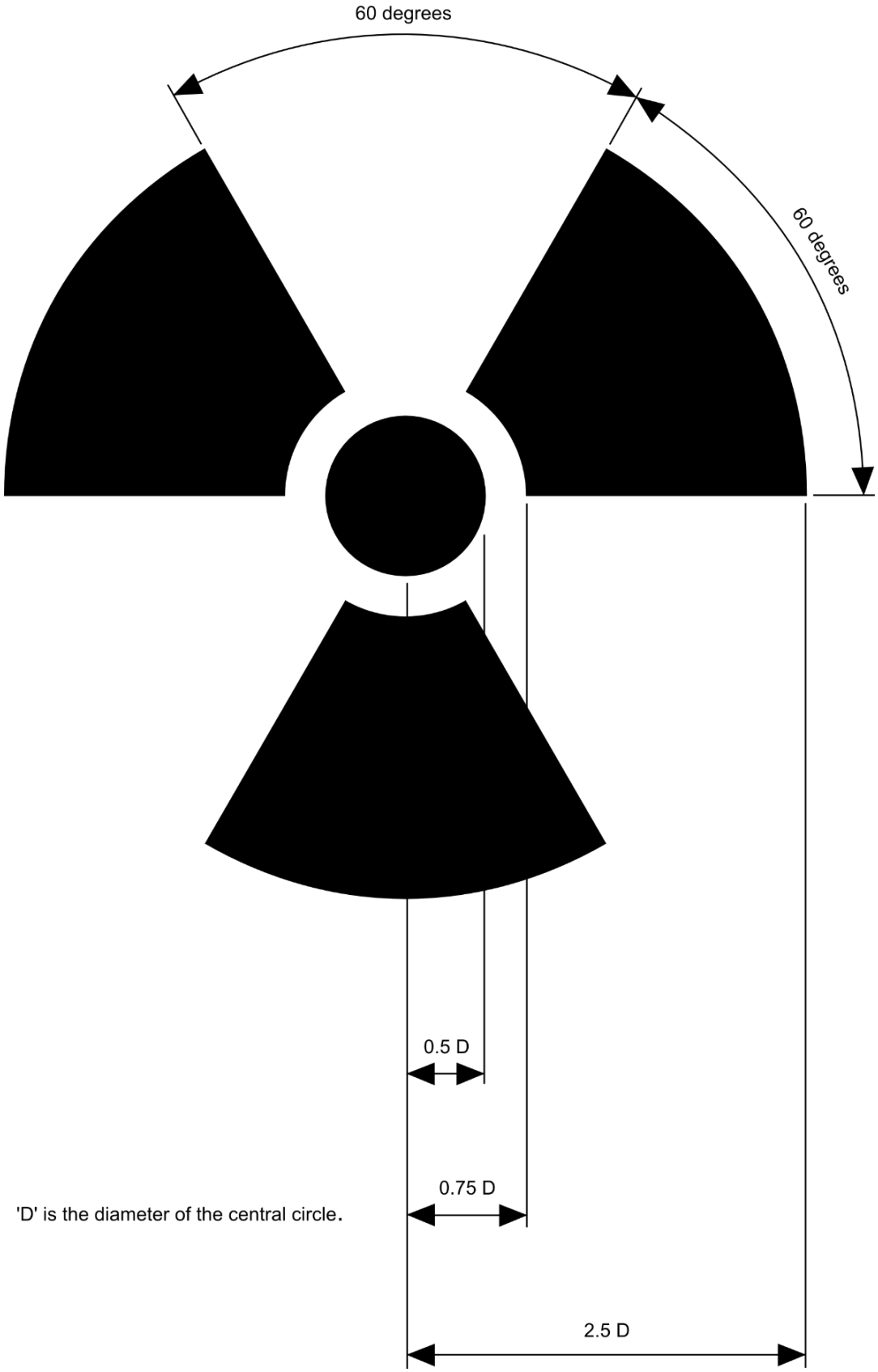
39.2 Legislative reference

Schedule 3, test 32, *Code of Compliance for medical, veterinary and chiropractic X-ray radiation apparatus 2022*.

Schedule 1 – Radiation symbol

(1) The *radiation symbol* consists of the conventional three blade design shown overleaf.

(2) The symbol and background colours must comply with the requirements of *AS 1319–1994 Safety Signs for the Occupational Environment*.



'D' is the diameter of the central circle.

Document history

Publications

This first release of this document replaces *Test Protocol for medical and veterinary fluoroscopy X-ray apparatus 2016*, which became obsolete on 11 February 2023.

Title	Release	Commencement
Test Protocol for medical and veterinary fluoroscopy X-ray apparatus 2023	first release	11.2.2023