

Radiation Safety Act 1999

RADIATION SAFETY STANDARD

HR002:2010

Standard for radiation apparatus used to carry out radiology

Preface

This radiation safety standard, HR002:2010 *Standard for radiation apparatus used to carry out radiology* is made under section 16 of the *Radiation Safety Act 1999*, and establishes the minimum safety criteria for radiation apparatus used to carry out radiology involving the irradiation of humans. Compliance with this standard will assist possession licensees in ensuring that health and safety of persons are not adversely affected by exposure to radiation during radiology procedures.

This radiation safety standard, which is based on information derived from reputable sources such as Standards Australia and the Australasian College of Physical Scientists and Engineers in Medicine, was prepared after extensive consultation with industry and licensees.

By ensuring compliance with this radiation safety standard, radiation safety in radiology practices across Queensland will be enhanced. Queensland Health will also ensure that the standard is reviewed periodically to assure its currency and its appropriateness for diagnostic radiation apparatus used for radiology.

I, Paul Lucas, Deputy Premier and Minister for Health, pursuant to section 16(1) of the *Radiation Safety Act 1999*, make the radiation safety standard HR002:2010 *Standard for radiation apparatus used to carry out radiology*, for the purposes of the Act, and repeal the previous standard HR002:2004 *Standard for radiation apparatus used to carry out radiology*.

SIGNED

PAUL LUCAS MP
Deputy Premier
Minister for Health

19 / 08 / 2010

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Standard for radiation apparatus used to carry out radiology

Section 1 – General

1.1 Scope

This radiation safety standard sets out the minimum requirements for ionising radiation apparatus that is used for radiology involving the irradiation of humans.

1.2 Expiry

This radiation safety standard expires on 1 September 2020.

1.3 Definitions

In this standard -

“**coefficient of variation**” means the ratio of the sample standard deviation to the mean value of a series of measurements.

“**continuous mode**” means, for an X-ray generator, mode of loading an X-ray tube continuously as in radiotherapy or in radiology or fluoroscopy.

“**effective focal spot size**” means the size of the perpendicular projection of the actual focal spot on the reference plane.

“**equivalent dimensions**” means dimensions as determined by the star pattern measurement method according to:

$$F = N/57.3 \times D/(M-1)$$

where M is the magnification (diameter of the image of the star pattern divided by the diameter of the star phantom)
D is diameter of blur region
N is angle of pattern lines in degrees

“**focal spot to image receptor distance**” means the distance from the focal spot to the point at which the reference axis intersects with the image receptor plane.

“**high level or boost mode**” means a mode where the air kerma entrance rate, as measured in Appendix B, may exceed 100 mGy in one minute.

“**image acquisition**” means the acquisition of intermittent image sequences where the image presentation is not primarily intended for simultaneous and immediate observation and the acquired images are automatically captured and stored for later clinical or diagnostic reference.

“**image reception area**” means the active surface of the image receptor at the time an X-ray pattern is received.

“**intermittent mode**” means, for an X-ray generator, mode of loading an X-ray tube where the electric energy is supplied to the tube in single, intermittent or pulsed loadings, as for example in radiography, cineradiography.

“irradiation time” means the duration of an irradiation determined by:

- (i) for single phase units, the irradiation time is determined by counting the total number of pulses in the radiation waveform and multiplying by a factor of 0.02 if half rectified or a factor of 0.01 if full wave rectified.
- (ii) for other units, the irradiation time is determined from the time that the kilovoltage has risen the first time to a value above 65%, but not higher than 85% of the peak kilovoltage value, until the time at which it finally drops below the same value.

“kVp” (X-ray tube voltage) means the potential difference, applied to an X-ray tube between the anode and the cathode, which is expressed by its peak value in kilovolts (kVp).

“leakage air kerma” means air kerma produced by ionising radiation which has passed through the protective shielding of a radiation source as well as that which, for some types of X-ray generators, has passed through the radiation aperture before and after loading (e.g. one containing a grid controlled X-ray tube). Leakage air kerma is usually expressed in milligray (mGy) or microgray (μ Gy).

“loading” means the act of supplying electrical energy to the anode of an X-ray tube.

“mA” (X-ray tube current) means the electric current of the electron beam incident on the target of an X-ray tube, which is expressed by its mean value in milliamperes (mA).

“mAs” (current time product) means the electric charge resulting from the loading of an X-ray tube, expressed in milliamperere seconds (mAs), as the product of the mean X-ray tube current in milliamperes and the duration of the loading in seconds.

“optical density” means the common logarithm of the ratio of the amount of light striking one side of the film to the amount of light that passes through the film.

“radiography” means the production of an image of an object on film, or other kind of image receptor, by means of X-radiation, the contrast between different areas of the image being the result of differential interaction of the radiation in the object.

“radioscopy” means the technique for obtaining, continuously or periodically, a sequence of X-ray patterns and presenting them simultaneously and continuously as visible images. For the purpose of tests related to air kerma or image quality assessment, radioscopy or fluoroscopy excludes image acquisition. Radioscopy includes fluoroscopy.

“total permanent filtration” means inherent filtration and other filtration not removable without the use of tools.

Section 2 - Standard – Radioscopic Radiation Apparatus

Test	Compliance Test	Criteria for Passing the Test
Accuracy and reproducibility		
1	Reproducibility	The coefficient of variation of 5 consecutive radiation output measurements, at loading factors of approximately 70 kVp, 200 mA and 50 milliseconds, must not exceed 0.05.
2	Linearity	<p>The following conditions must be met using a kVp value of approximately 70 kVp and, if the equipment provides for such adjustments to be made, at least 4 pairs of mA (or mAs) stations including the lowest and the highest available. The test must be performed for each focal spot size.</p> $\frac{\left \frac{K_1}{Q_1} - \frac{K_2}{Q_2} \right }{\frac{K_1}{Q_1} + \frac{K_2}{Q_2}} \leq 0.1$ <p>for values of Q_1 and Q_2 where $0.5 \leq \frac{Q_2}{Q_1} \leq 2$; and/or</p> $\frac{\left \frac{K_1}{I_1 t_1} - \frac{K_2}{I_2 t_2} \right }{\frac{K_1}{I_1 t_1} + \frac{K_2}{I_2 t_2}} \leq 0.1$ <p>for values of $I_1 t_1$ and $I_2 t_2$ where $0.5 \leq \frac{I_2 t_2}{I_1 t_1} \leq 2$.</p> <p>Where: K_1 and K_2 are the measured values of air kerma Q_1 and Q_2 are the indicated current time products I_1 and I_2 are the indicated X-ray tube currents t_1 and t_2 are the indicated irradiation times</p> <p>Note: This test does not apply to capacitor discharge units.</p>

Test	Compliance Test	Criteria for Passing the Test
3	kVp accuracy	<p>The measured kVp:</p> <p>(a) should be within $\pm(5 \text{ percent} + 1 \text{ kVp})$, of the indicated value; and</p> <p>(b) must be within ± 10 percent of the indicated value.</p> <p>Note 1. The increment or decrement of the X-ray tube voltage between any two indicated settings must be within 50 percent and 150 percent of the indicated change.</p> <p>Note 2. The test must be performed for each focal spot size starting at 50 kVp and increasing in 10 kVp steps to 120 kVp or 10 kVp below the maximum selectable value whichever is the lesser.</p> <p>Further values above 120 kVp must be tested where these values are used clinically.</p> <p>Where the equipment is designated for a specific clinical application an alternative range of kVp settings consistent with the clinical application may be used for testing. In this case, the kVp range tested must be noted on the Assessment Report.</p> <p>Note 3. If the equipment does not meet the requirements of part (a), but does satisfy the requirements of part (b), a comment to this effect must be made on the Assessment Report.</p>
4	Timer accuracy	<p>The measured irradiation time must be within:</p> <p>(a) ± 10 percent of the indicated value for irradiation times 100 milliseconds or greater; and</p> <p>(b) ± 20 percent of the indicated value for irradiation times less than 100 milliseconds.</p> <p>Note: Measurements should be performed at approximately 70 kVp and 100 mA using at least 5 irradiation time settings. For medium or high frequency units, the time settings must range from 10 milliseconds to 500 milliseconds. For all other units, the time settings must range from 50 milliseconds to 500 milliseconds.</p>
5	Entrance skin air kerma	<p>At 70 kVp, the air kerma rate, at 1 metre from the focal spot, must not be less than 15 μGy per mAs.</p> <p>Note: This test is to be performed with only the total permanent filtration being in the irradiation field.</p>

Test	Compliance Test	Criteria for Passing the Test								
Output controls and limits										
6	Beam quality – half value layer	The total permanent filtration must be such that the measured first half-value layer is not less than 2.3 millimetres of aluminium at an indicated value of 80 kVp.								
7	X-ray source assembly leakage	The leakage air kerma averaged over any area of 100 square centimetres at one metre from the focal spot must not exceed 1 mGy in one hour with the X-ray tube operating at the maximum rated voltage and the maximum rated continuous current.								
8	Maximum air kerma rate	<p>The maximum air kerma rate during radiology or fluoroscopy must not exceed the following values when measured under the test conditions given in Appendix B:</p> <p>Systems with manual dose control only 50 mGy.min⁻¹</p> <p>Systems with automatic dose control (automatic and manual mode) 100 mGy.min⁻¹</p> <p>High level or boost mode 150 mGy.min⁻¹</p>								
9	Typical air kerma rates	<p>For systems capable of operation in automatic dose control mode:</p> <p>(a) the air kerma rate during radiology or fluoroscopy (other than high level or boost mode) must not exceed 50 mGy.min⁻¹ and should not exceed 20 mGy.min⁻¹ when measured under the test conditions given in Appendix C; and</p> <p>(b) if the air kerma during radiology or fluoroscopy (other than high level or boost mode) does exceed 20 mGy.min⁻¹, then the air kerma rate (other than high level or boost mode) at the input surface of the image receptor must not exceed the following values:</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;"><u>Field size</u> (millimetre)</th> <th style="text-align: center;"><u>Air kerma rate</u> (μGy.min⁻¹)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">< 140</td> <td style="text-align: center;">120</td> </tr> <tr> <td style="text-align: center;">140 to < 230</td> <td style="text-align: center;">80</td> </tr> <tr> <td style="text-align: center;">≥ 230</td> <td style="text-align: center;">60</td> </tr> </tbody> </table> <p>Note: For part (b), sufficient copper filtration is to be added to the X-ray beam for the automatic dose control to set the X-ray tube voltage to between 70 kVp and 80 kVp. Additionally, any anti-scatter radiation grid is to be removed or a traceable grid correction factor applied to the measurement obtained (with a grid in-situ).</p>	<u>Field size</u> (millimetre)	<u>Air kerma rate</u> (μGy.min ⁻¹)	< 140	120	140 to < 230	80	≥ 230	60
<u>Field size</u> (millimetre)	<u>Air kerma rate</u> (μGy.min ⁻¹)									
< 140	120									
140 to < 230	80									
≥ 230	60									

Test	Compliance Test	Criteria for Passing the Test								
10	Minimum focus to skin distance	The minimum focus to skin distance must not be able to be less than 200 millimetres.								
11	Image receptor in place	It must not be possible to initiate radioscopic loading without an image receptor in place to fully intercept the X-ray beam.								
Image quality determinants										
12	Image quality	<p>The equivalent dimensions of focal spot sizes:</p> <p>(a) should not exceed the relevant values specified in Appendix A for the nominal focal spot size; and</p> <p>(b) must not exceed equivalent dimensions of 2.6 millimetres width and 3.7 millimetres length.</p> <p>Note: If the equipment does not meet the requirements of part (a), but does satisfy the requirements of part (b), a comment to this effect must be made on the Assessment Report.</p> <p>Alternatively, another image quality test, approved by the Chief Executive, may be used.</p>								
13	Image uniformity	<p>An image of grids in-situ within their image receptor must be spatially uniform and free from clinically significant artifacts.</p> <p>The image must be obtained using a clinically representative air kerma at the image receptor and loading factors of approximately 70 kVp and at least 100 milliseconds using a focus to image receptor distance within the focal range of the grid.</p>								
14	High contrast resolution	<p>Using a Westmead or similar test object attached to the face of the image receptor, the high contrast resolution as displayed on a clinical reference monitor during radioscopy or fluoroscopy must be greater than or equal to:</p> <table border="0" data-bbox="608 1624 1093 1780"> <thead> <tr> <th data-bbox="608 1624 758 1691"><u>Field size</u> (millimetre)</th> <th data-bbox="909 1624 1093 1691"><u>Line pairs</u> (per millimetre)</th> </tr> </thead> <tbody> <tr> <td data-bbox="608 1691 758 1720">< 140</td> <td data-bbox="909 1691 1093 1720">1.6</td> </tr> <tr> <td data-bbox="608 1720 758 1749">140 to < 230</td> <td data-bbox="909 1720 1093 1749">1.2</td> </tr> <tr> <td data-bbox="608 1749 758 1780">≥ 230</td> <td data-bbox="909 1749 1093 1780">0.8</td> </tr> </tbody> </table> <p>Note: This test must be performed using an optimised combination of imaging mode, image acquisition and image processing parameters.</p>	<u>Field size</u> (millimetre)	<u>Line pairs</u> (per millimetre)	< 140	1.6	140 to < 230	1.2	≥ 230	0.8
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< 140	1.6									
140 to < 230	1.2									
≥ 230	0.8									

Test	Compliance Test	Criteria for Passing the Test								
15	Low contrast resolution	<p>Using a Westmead or similar test object attached to the face of the image receptor, and 2 millimetres of copper in the beam positioned as close as practicable to the collimator, the low contrast resolution as displayed on a clinical reference monitor during radioscopy or fluoroscopy must be greater than or equal to:</p> <p>(a) 5 percent for 10 millimetre diameter detail (for a Westmead test object, at least 9 of the 10 millimetre diameter circles must be detectable); and</p> <p>(b) 15 percent for a 1 millimetre diameter detail (for a Westmead test object, 1.5 millimetres on the low contrast detectability section which is 10 percent is acceptable).</p> <p>Note 1. The test must be performed using an optimised combination of imaging mode, image acquisition and image processing parameters.</p> <p>Note 2. The test must be performed using an (non-boost) automatic dose control mode, where available.</p> <p>Note 3. For systems that do not have a fully automatic dose control mode of operation, select technique factor(s) such that approximately 70kVp is obtained.</p> <p>Note 4. For systems with manual dose control only, the test must be performed using values not exceeding the following image receptor input air kerma rates:</p> <table border="1" data-bbox="715 1227 1193 1384"> <thead> <tr> <th>Field size (millimetre)</th> <th>Air kerma rates ($\mu\text{Gy}\cdot\text{min}^{-1}$)</th> </tr> </thead> <tbody> <tr> <td>< 140</td> <td>120</td> </tr> <tr> <td>140 to < 230</td> <td>80</td> </tr> <tr> <td>≥ 230</td> <td>60</td> </tr> </tbody> </table>	Field size (millimetre)	Air kerma rates ($\mu\text{Gy}\cdot\text{min}^{-1}$)	< 140	120	140 to < 230	80	≥ 230	60
Field size (millimetre)	Air kerma rates ($\mu\text{Gy}\cdot\text{min}^{-1}$)									
< 140	120									
140 to < 230	80									
≥ 230	60									
16	X-ray tube housing stability	The X-ray tube housing must remain stationary during loading unless it is intended to move.								
Operator controls and indicators										
17	Irradiation switch on mobile radiation apparatus	<p>There must be an irradiation switch fitted to a mobile radiation apparatus which will allow the operator to be positioned at least 2 metres from the X-ray tube.</p> <p>Note: This test does not apply to radiation apparatus if it can be shown that the air kerma rate will not exceed 10 $\mu\text{Gy}/\text{min}$ at the operator's hand/foot position.</p>								

Test	Compliance Test	Criteria for Passing the Test
18	Initiation and termination of loading	<p>Each loading must be initiated and maintained by means of a control requiring continuous actuation by the operator.</p> <p>Means shall be provided for the operator to terminate each loading at any time before its intended completion, except during serial radiography or for single loadings with a loading time of 0.5 seconds or less.</p>
19	Loading indication	<p>There must be a specific and conspicuous audible signal indicating loading in the high level or boost mode.</p>
20	Supply indication	<p>When the apparatus is energised, this status must be clearly indicated.</p> <p>The supply indicator and the load indicator must be clearly labelled or otherwise easily distinguishable from each other.</p>
21	Indication if more than one X-ray tube	<p>If there is more than one X-ray tube incorporated in the apparatus, the selected tube must be clearly indicated.</p>
22	Indication of radioscopy or fluoroscopy time	<p>The system must have a radioscopy or fluoroscopy timer, and:</p> <p>(a) the timer must provide an audible signal at intervals not exceeding 5 minutes; and</p> <p>(b) means must be provided for the timer to be reset to zero.</p>
23	Loading indication – intermittent mode	<p>Loading in the intermittent mode must be indicated by a visible signal. Additionally, an audible signal must be provided which indicates either the duration or the instant of termination of loading.</p>
24	Loading indication – continuous mode	<p>Loading in the continuous mode must be indicated by a specific visible signal.</p>
25	Loading factors	<p>Loading factors must be continuously displayed.</p>
26	Focal spot marking	<p>The position of the focal spot must be clearly and visibly indicated.</p>
Field indication, limitation and alignment		
27	Light field intensity	<p>If a light beam diaphragm is fitted to the radiation apparatus, the illuminance of the light field indicator must not be less than 100 lux at 1 metre from the focal spot of the X-ray tube.</p>

Test	Compliance Test	Criteria for Passing the Test
28	X-ray/light field alignment	<p>If a light beam diaphragm is fitted to the radiation apparatus:</p> <p>(a) the extent of misalignment between any boundary of the light field and the equivalent boundary of the X-ray field in the plane of the image receptor must not exceed 1 percent of the focus to image receptor distance; and</p> <p>(b) the central axis of the X-ray beam must coincide with the central axis of the light field to within ± 1.4 degrees (e.g. for a 20 centimetre high field alignment test tool, the top test object must be within 5 millimetres of the bottom test object).</p>
29	X-ray field/image receptor – radioscopy	<p>If the X-ray beam is rectangular, and the image receptor is circular, the length and width of the X-ray beam must fall within the image receptor area.</p> <p>For X-ray beams that are not rectangular, the discrepancy between any edge of the X-ray beam axis and the corresponding visible edge of the image on the television monitor must not exceed 1.5 percent of the focal spot to image receptor distance.</p> <p>Note: A representative sample of the clinically used combinations of focal spot to image receptor distance and image receptors must be tested.</p>
30	X-ray field/image receptor – radiography	<p>For systems with fixed or automatic alignment of the X-ray tube assembly and the image receptor assembly, in modes of operation where a light field indicator is not fitted or can not be used:</p> <p>(a) any boundary of the X-ray beam must not fall more than 1.5 percent of the focus to image receptor distance outside of the equivalent boundary of the image reception area; and</p> <p>(b) for spot film imaging, the boundaries of adjacent segmental images must not overlap.</p> <p>However, if the X-ray beam is rectangular, and the image receptor is circular, the length and width of the X-ray beam must fall within the image receptor.</p> <p>For all other systems where a light field is not fitted or can not be used, the size and position of the X-ray beam must comply with manufacturer's specifications.</p> <p>Note: A representative sample of the clinically used combinations of focal spot to image receptor distance and image receptors must be tested.</p>

Test	Compliance Test	Criteria for Passing the Test
Automatic exposure control systems		
31	Reproducibility	<p>(a) Using the centre detector, the air kerma from 5 consecutive loadings at 80 kVp with a patient equivalent phantom must be within ± 10 percent of the mean; and</p> <p>(b) the air kerma from irradiations to the lateral detectors must be within 10 percent of each other.</p> <p>Note: For this test, phantoms constructed of 2 millimetres of copper or 15 centimetres of acrylic are suitable substitutes for a patient equivalent phantom.</p>
32	kVp compensation	<p>For systems utilising a film-screen image receptor system the optical density of the images of a patient equivalent phantom using 60, 80, 100 and 120 kVp must not differ by more than 0.20 from the mean optical density. The mean optical density must be in the range 0.5 to 2.0.</p> <p>Note 1. Where the equipment is designated for a specific clinical application an alternative range of kVp settings consistent with the clinical application must be used for testing.</p> <p>Note 2. For systems exclusively utilising a digital image receptor the variation in radiation dose absorbed by the receptor (e.g. as indicated by the exposure index) should not exceed that implied by the optical density variation allowed for film-screen image receptor systems. (Note: radiographic mode only).</p> <p>Note 3. For this test, a phantom constructed of 15 centimetres of acrylic is a preferable patient equivalent phantom.</p>
33	Thickness compensation	<p>The optical density of four pairs of exposures made at the following parameters must not differ by more than 0.2 from the other value in the pair.</p> <p>(a) 60kVp with 10 and 15 centimetre acrylic phantoms; and</p> <p>(b) 80kVp with 15 and 20 centimetre acrylic phantoms; and</p> <p>(c) 100kVp with 15 and 20 centimetre acrylic phantoms; and</p> <p>(d) 120kVp with 10 and 15 centimetre acrylic phantoms.</p>
34	Minimum response time	<p>The minimum response time of the automatic exposure control to radiation must not exceed 10 milliseconds, except for single phase systems where it must not exceed 20 milliseconds.</p>
35	Indication of automatic exposure control	<p>There must be a visible indication when the automatic exposure control function is selected.</p>

Test	Compliance Test	Criteria for Passing the Test
36	Indication of detector(s) selected	<p>There must be a visible indication of the image receptor selected and the automatic exposure control detector(s) active.</p> <p>For clarification, the automatic exposure control must only be able to be operated if the image receptor selected is equipped with an automatic exposure control detector.</p>
37	Density control	Where the operator can alter the sensitivity of the detectors, this adjustment must cause a change in air kerma consistent with manufacturer's instructions for use.
38	Failsafe timer – 600mAs operation	A failsafe timer must be provided and must limit any loading to not more than 60 kilojoules or the current time product to no more than 600 mAs.
39	Failsafe timer – 600mAs indication	A visible indication must be provided whenever a loading has been terminated by the failsafe timer.
40	Failsafe timer – 600mAs reset	When a loading has been terminated by the failsafe timer it must not be possible to initiate another loading without first operating a manual reset.
41	Preset exposure limit indication	A visible or audible signal must be provided whenever a loading has been terminated by a preset exposure limit.
<i>Tomographic performance</i>		
42	Resolution	The system must resolve a 40 mesh (1.6 holes/millimetre) screen pattern or better.
43	Section thickness	The section thickness must comply with manufacturer's specifications or instructions for use.
44	Section levels	Agreement between the indicated and measured section levels must be within ± 5 millimetres.
45	Irradiation uniformity and pattern	The density of the image of the hole in the lead sheet of a phantom must be nearly uniform or must vary in uniformity according to the pattern expected. The image must reveal no unexpected overlaps, inconsistencies of irradiation or asymmetry in motion.

Test	Compliance Test	Criteria for Passing the Test
<i>Radiation warning sign</i>		
46	Radiation warning sign	<p>The radiation apparatus must be marked with a sign or label incorporating the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • the words "caution" or "warning" • words to the general form of "X-rays produced when energised" <p>The symbol and lettering must be black on a yellow background.</p>

Appendix A

Permissible Values of Focal Spot Dimensions for Nominal Focal Spot Values

Nominal Focal Spot Value	Permissible Values (in mm)	
	Width	Length
F		
0.1	0.10 ... 0.15	0.10 ... 0.15
0.15	0.15 ... 0.23	0.15 ... 0.23
0.2	0.20 ... 0.30	0.20 ... 0.30
0.25	0.25 ... 0.38	0.25 ... 0.38
0.3	0.30 ... 0.45	0.45 ... 0.65
0.4	0.40 ... 0.60	0.60 ... 0.85
0.5	0.50 ... 0.75	0.70 ... 1.10
0.6	0.60 ... 0.90	0.90 ... 1.30
0.7	0.70 ... 1.10	1.00 ... 1.50
0.8	0.80 ... 1.20	1.10 ... 1.60
0.9	0.90 ... 1.30	1.30 ... 1.80
1.0	1.00 ... 1.40	1.40 ... 2.00
1.1	1.10 ... 1.50	1.60 ... 2.20
1.2	1.20 ... 1.70	1.70 ... 2.40
1.3	1.30 ... 1.80	1.90 ... 2.60
1.4	1.40 ... 1.90	2.00 ... 2.80
1.5	1.50 ... 2.00	2.10 ... 3.00
1.6	1.60 ... 2.10	2.30 ... 3.10
1.7	1.70 ... 2.20	2.40 ... 3.20
1.8	1.80 ... 2.30	2.60 ... 3.30
1.9	1.90 ... 2.40	2.70 ... 3.50
2.0	2.00 ... 2.60	2.90 ... 3.70

Extract from Australian/New Zealand Standard AS/NZS 4274:1995 *X-ray tube assemblies for medical diagnosis – characteristics of focal spots*

Appendix B

Radioscopy - Test Conditions for Maximum Air Kerma Rate

Test Conditions

System Configuration	Dosemeter Positions
<p>UNDER-TABLE X-RAY TUBE</p> <p>When a patient support is permanently between the X-ray tube assembly and the position of the patient.</p>	<p>10 millimetres from the patient support on the patient side of the support.</p>
<p>OVER TABLE X-RAY TUBE</p> <p>When a patient support is permanently between the position of the patient and the X-ray image receptor.</p>	<p>300 millimetres above the patient support on the X-ray tube side of the support.</p>
<p>C OR U ARM SYSTEMS</p> <p>Where the X-ray tube and the image receptor are mechanically linked and where a patient support may or may not be permanently in the radiation beam.</p>	<p>300 millimetres from the image receptor plane but not less than 400 millimetres from the focal spot.</p>

Appendix C

Radioscopy - Measurement of Typical Air Kerma Rate

Test Conditions

System Configuration	Dosemeter and System Positions
UNDER-TABLE X-RAY TUBE When a patient support is permanently between the X-ray tube assembly and the position of the patient	Dosemeter: 10mm from the patient support on the patient side of the support System: Image receptor 300mm above patient support
OVER-TABLE X-RAY TUBE When a patient support is permanently between the X-ray tube assembly and the position of the patient	Dosemeter: 300mm above the patient support on the X-ray tube side of the support System: Focus to image receptor distance as near as possible to 1000mm
C OR U ARM SYSTEMS Where the X-ray tube and the image receptor are mechanically linked and where a patient support may or may not be permanently in the radiation beam	Dosemeter: 300mm from the image receptor plane System: Focus to image receptor distance as near as possible to 1000mm

Note

For each of the above configurations, 20 centimetres of polymethylmethacrylate (e.g. Perspex, acrylic) or equivalent must be placed between the dosimeter and image receptor. Each non-boost automatic dose control mode must comply with the stated limits. Dose measurements are to be obtained free-in-air (i.e. no backscatter). The selected image reception area's largest dimension (field size) must be as near as possible to 23 centimetres.

If the automatic dose control requires the selection of either kVp or mA, then the system must be adjusted such that approximately 80 kVp is obtained.