

Radiation Safety Act 1999

RADIATION SAFETY STANDARD

PR100:2010

Standard for Premises - Ionising Radiation Sources

Preface

This radiation safety standard, *Standard for Premises – Ionising Radiation Sources*, is made under section 16 of the *Radiation Safety Act 1999*, and establishes the minimum safety criteria for premises at which ionising radiation sources are used, or where radioactive substances are stored. Compliance with this standard will assist possession licensees in ensuring that the health and safety of persons are not adversely affected by exposure to radiation during the conduct of their radiation practices.

This radiation safety standard was prepared after extensive consultation with industry and licensees. It replaces the following radiation safety standards:

- PR001:1999 *Standard for premises at which radiation sources are used to carry out a radiation practice*
- PR002:1999 *Standard for premises at which radioactive substances are stored*
- PR003:1999 *Standard for premises at which radiation sources are used to carry out industrial radiography, excluding open sites*
- PR004:2004 *Standard for premises in which an ionising radiation apparatus is used to carry out health related diagnostic radiography or radiation therapy*
- PR005:1999 *Standard for premises at which radiation apparatus is used to carry out veterinary diagnostic radiography or veterinary radiation therapy*
- PR006:1999 *Standard for premises at which radiation sources are used to carry out industrial gauging*
- PR007:1999 *Standard for premises at which radiation apparatus is used to carry out chemical analysis*
- PR009:1999 *Standard for premises at which radiation sources are used to carry out sterilisation*

The revision of the abovementioned standards was considered necessary to clarify the meaning and intent of some tests, to correct technical errors, to ensure consistency of terminology across all Standards relating to premises, and to improve the reproducibility of the test results. The amalgamation of the tests into one document was done, in part, to clarify that irrespective of the particular type of radiation practice the fundamental standards for achieving and ensuring human health are the same, despite some understandable practice-related differences.

By ensuring compliance with this radiation safety standard, radiation safety across Queensland will continue to be in accordance with, and improve upon, the high standard for radiation safety achieved in this State for many years. Queensland Health will also ensure that the standard is reviewed periodically to assure its currency and its continued appropriateness for premises at which radiation sources are used, or where radioactive substances are stored.

I, Paul Lucas, Deputy Premier and Minister for Health, pursuant to section 16(1) of the *Radiation Safety Act 1999*, hereby make the radiation safety standard *Standard for Premises – Ionising Radiation Sources*, for the purposes of the Act, and rescind the standards listed above.

SIGNED

PAUL LUCAS MP
Deputy Premier
Minister for Health

19 / 08 / 2010

Contents

Section 1 – General

- 1.1 Introduction
- 1.2 Scope
- 1.3 Expiry
- 1.4 Definitions

Section 2 – Principal Requirement

- 2.1 Principal requirement for all premises where ionising radiation related practices are carried out

Section 3 – Specific Requirements for Each Practice Type

- 3.1 Requirements, in addition to the principal requirement, for premises used to store radioactive substances
- 3.2 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out diagnostic radiography (including veterinary diagnostic radiography)
- 3.3 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out radiation therapy (including veterinary radiation therapy)
- 3.4 Requirements, in addition to the principal requirement, for premises in which a radioactive substance is used to carry out high or pulsed dose rate brachytherapy using a remote afterloading brachytherapy machine
- 3.5 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out chemical analysis
- 3.6 Requirements, in addition to the principal requirement, for premises in which a radiation source is used to carry out industrial gauging
- 3.7 Requirements, in addition to the principal requirement, for premises in which a radiation source is used to carry out industrial radiography
- 3.8 Requirements, in addition to the principal requirement, for premises in which a machine source irradiator is used
- 3.9 Requirements, in addition to the principal requirement, for premises in which a sealed source irradiator is used
- 3.10 Requirements, in addition to the principal requirement, for premises in which a radiation source is used as part of a nuclear medicine practice
- 3.11 Requirements, in addition to the principal requirement, for all premises not listed in 3.1 to 3.10 in which radioactive substances are used (including veterinary radiotherapy)

Standard for Premises – Ionising Radiation Sources

Section 1 – General

1.1 Introduction

This radiation safety standard sets out the minimum requirements for premises in which ionising radiation sources are used to carry out a radiation practice, or where radioactive substances are stored.

These requirements are made to ensure that the immediate environment around a particular radiation source is sufficient to ensure the protection of all persons and the environment from the radiation emitted as a result of using the source to carry out a radiation practice, or as a result of storing radioactive substances.

1.2 Scope

The standard specifically targets:

- (a) premises comprising a room or an area within a room, building or other structure in which a radiation source is used to carry out a radiation practice
- (b) premises comprising a site where a radiation source is installed for industrial gauging purposes
- (c) premises comprising a room, building or other structure where radioactive substances are stored.

For clarification, this standard applies to:

1. Premises where bone mineral densitometry X-ray equipment is used. These premises must comply with Section 2.1 *Principal requirement for all premises where ionising radiation related practices is carried out* and with Section 3.2 *Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out diagnostic radiography (including veterinary diagnostic radiography)*.
2. Partially enclosed and fully enclosed sites which are used to conduct industrial radiography.

This standard applies to premises in which radiation sources are used, and where radioactive substances are stored; but it does **not** apply if the only sources being used in the premises are the following:

- (a) mobile ionising radiation apparatus used on humans for diagnostic purposes which is not used regularly in premises consisting of or comprising a room or an area within a room

Note: For the purposes of this standard, mobile ionising radiation apparatus (excluding dental X-ray equipment) is considered to be used regularly in a room if the radiation apparatus is used in the room to the extent that, during any one week period, the threshold amount of radiation is exceeded.

- (b) non-ionising radiation apparatus
- (c) fully enclosed analytical radiation apparatus

- (d) hand held radiation sources used for elemental analysis and bench top analysers containing radiation sources
- (e) cabinet radiation apparatus
- (f) sealed radioactive substances incorporated in a liquid scintillation counters
- (g) sealed radioactive substance incorporated in a static eliminators
- (h) self contained irradiators.

1.3 Expiry

This radiation safety standard expires on 1 September 2020.

1.4 Definitions

In this standard –

accessible area

means an area where there are no mechanisms preventing a person from gaining access to the particular area.

control area

means –

- (a) an area in which a radiation source control panel is protected by a fixed barrier; or
- (b) a room, housing a radiation source control panel, that is adjacent to a radiation source room.

diagnostic radiography

is a practice in which images of parts of the body or internal organs are produced, whether by direct or computer assisted means, to assist with the clinical diagnosis or treatment of a disease or condition, including radiotherapy treatment planning.

dose rate

means the equivalent dose of radiation absorbed or emitted during an period, usually measured more or less instantaneously but expressed in terms of $\mu\text{Sv}\cdot\text{h}^{-1}$.

fully enclosed site

means premises used specifically for industrial radiography in which the irradiation area is completely enclosed by shielding, including walls, floor and ceiling, and within which no person is permitted to remain during a radiographic exposure.

high level radioisotope laboratory

means a grade of laboratory as defined by the *Australian Standard Safety in Laboratories Part 4: Ionizing radiations*. AS 2243.4-1998¹.

industrial gauging

is a practice where a radiation source is used in a mining or manufacturing process or for a quality or process control application. This application includes the non-invasive measurement and control of the thickness, level, density, weight composition or moisture content in an industrial production process. The radiation source is generally installed in a fixed position and can only be removed by the use of tools.

industrial radiography

means the use of ionising radiation to obtain information non-destructively (usually in the form of an image) about the physical condition of objects and materials.

¹ Copies of the Australian Standard are available from SAI Global Limited: www.saiglobal.com.

loaded state

means the state during the operation of ionising radiation apparatus when ionising radiation is being produced.

low level radioisotope laboratory

means a grade of laboratory as defined by the *Australian Standard Safety in Laboratories Part 4: Ionizing radiations*. AS 2243.4-1998¹.

machine source

means a radiation apparatus which is capable of producing ionising radiation using electricity as the energy source.

machine source irradiator

means a device used for irradiating things, using a machine source as the source of radiation, for purposes such as disinfestation, decontamination and sterilisation.

medium level radioisotope laboratory

means a grade of laboratory as defined by the *Australian Standard Safety in Laboratories Part 4: Ionizing radiations*. AS 2243.4-1998¹.

partially enclosed site

means a premises used specifically for industrial radiography in which all objects exposed to direct radiation are completely contained inside a permanent, shielded enclosure:

- (a) having walls at least 2.1 metres high;
- (b) which is typically open at the top to permit the transfer in and out of the objects to be radiographed; and
- (c) within which no person is permitted to remain during an exposure.

preparatory state

means the state during the operation of radiation apparatus when the apparatus is ready to produce radiation (i.e. the state of the apparatus immediately before pressing the exposure button).

radiation level

means absorbed dose in a specified period.

radiation shield

means the material which has as its primary function the attenuation of radiation emitted by a radiation source.

radiation source room

means:

- (a) a room, or a fixed and discernable part of a room, or an identifiable discrete part of the room, in which a particular radiation source is energised or used to carry out a radiation practice; or
- (b) a room, or a fixed and discernable part of a room, or an identifiable discrete part of the room, which is used to store radioactive substances; or
- (c) in the case of industrial gauging, any area defined by a barrier designed to prevent access to the radiation source. If there is no barrier, the shielding surrounding the X-ray tube or radioactive substance itself is considered to be the radiation source room; or
- (d) in the case of a nuclear medicine facility, the controlled area within the facility.

Note: For the purposes of this standard, 'controlled area' mean the defined area in which specific protection measures and safety provisions are required for:

- (a) controlling normal exposures or preventing the spread of contamination during normal working conditions; and
- (b) preventing or limiting the extent of potential exposures.

readily cleanable

means able to be cleaned easily using commonly available cleaning methods and products for the purpose of removing radioactive contamination.

sealed source irradiator

means a device used for irradiating things for purposes such as disinfestation, decontamination or sterilisation, in which the source of radiation is a sealed radioactive substance which is kept in a storage pool (a part of the device, usually containing water) when the device is not in use.

self contained irradiator

means a device used for irradiating things for purposes such as disinfestation, decontamination, sterilisation or specialist radiation-related research studies in which the source of radiation is a sealed radioactive substance, securely enclosed within the device, and in which the shielding required for safe operation of the device and safe and secure storage of the source when the device is not in use, is an integral part of the device.

store (n)

is a specifically nominated place where access to radioactive substances is controlled, and no use occurs. For clarification, a radioactive substance placed to one side during intermittent use is not considered to be stored.

store (v)

to place a radioactive substance in a specifically nominated place where access is controlled, and no use occurs. For clarification, a radioactive substance placed to one side during intermittent use is not considered to be stored.

threshold amount of radiation

means, for apparatus used for diagnostic radiography (including radioscopy), an amount of radiation equivalent to the amount generated if:

- (a) an ionizing radiation apparatus without a primary beam stop is operated at a potential of 90 kV and workload of 1 mAmin; or
- (b) an ionizing radiation apparatus incorporating a primary beam stop is operated at a potential of 90 kV and workload of 10 mAmin.

Section 2 – Principal Requirement

2.1 Principal requirement for all premises where ionising radiation related practices are carried out

Test	Compliance Test	Criteria for Passing the Test
2.1.1	External effective dose	<p>As a result of the radiation practice being carried out in the radiation source room being assessed, an individual must not be able to receive an effective dose greater than:</p> <ul style="list-style-type: none"> (a) 10 μSv per week in a Type 1 area (b) 40 μSv per week in a Type 2 area (c) 40 μSv per week in a Type 3 area <p>Note 1: For this test, an individual is not considered to be a member of the public or a person who is occupationally exposed to radiation if the person is the subject of a diagnostic or therapeutic procedure in the radiation source room.</p> <p>Note 2: For this test, the circumstances to be considered for each source will be unique and hence all variables, such as orientation variations of the source, workload in particular orientation, occupancy within and outside the room, radiation type and level of emission, need to be considered.</p> <p>Note 3: For this test, consideration must be given to the location and the use of each of the sources within the room.</p> <p>Note 4: For this test, a:</p> <p>‘Type 1 area’ is -</p> <ul style="list-style-type: none"> (i) any area or place external to the radiation source room being assessed, and (ii) able to be accessed by members of the public or persons who are occupationally exposed but who are not involved in carrying out a radiation practice for the possession licensee at the premises. <p>‘Type 2 area’ is -</p> <ul style="list-style-type: none"> (i) any area or place within the premises but outside of the radiation source room being assessed, and (ii) normally only occupied by occupationally exposed persons involved in carrying out a radiation practice for the possession licensee at the premises. <p>‘Type 3 area’ is any area, within the radiation source room being assessed, that is protected by fixed or movable protective barriers or screens (e.g. operator consoles).</p> <p>Note 5: A place is able to be accessed if there are no mechanisms preventing a person from gaining access.</p>

Section 3 – Specific Requirements for Each Practice Type

3.1 Requirements, in addition to the principal requirement, for premises used to store radioactive substances

Test	Compliance Test	Criteria for Passing the Test
3.1.1	Radiation dose rate limit	In addition to the principal requirement for all premises, the dose rate measured at 30 centimetres from any accessible area or place external to the radiation source room must not exceed $10 \mu\text{Sv}\cdot\text{h}^{-1}$ due to the storage of radioactive substances in the room.
3.1.2	Radiation warning signs	<p>The radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • the word ‘caution’ or ‘warning’ • words to the effect of ‘store for radioactive substances’ <p>The symbol and lettering must be black on a yellow background.</p> <p>This sign must be conspicuous either prior to entry to the radiation source room, or immediately upon entry to the room.</p>
3.1.3	Contact information displayed	<p>The contact telephone number(s) of the radiation safety officer must be displayed either:</p> <p>(a) at each entrance to the radiation source room; or</p> <p>(b) in the radiation source room.</p>
3.1.4	Ventilation	Where radioactive material is likely to emit a radioactive gas, the radiation source room must have separate and adequate ventilation to the outside air to reduce the concentration of gaseous radioactive material to at or near background concentrations in a reasonable time.
3.1.5	Storage with other items	The radiation source room must not contain, or be in proximity to, other dangerous goods.
3.1.6	Storage of unsealed radioactive substances	If unsealed radioactive substances are stored in the radiation source room, the surfaces of the room must be readily cleanable.
3.1.7	Security	The hardware required to prevent access by unauthorised persons must be installed.

3.2 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out diagnostic radiography (including veterinary diagnostic radiography)

Test	Compliance Test	Criteria for Passing the Test
3.2.1	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of ‘caution – X-rays’ <p>The symbol and lettering must be black on a yellow background.</p> <p>Note: This requirement does not apply to:</p> <ul style="list-style-type: none"> (a) radiation source rooms in which only intra-oral dental diagnostic radiography equipment is used; or (b) rooms that can only be accessed from the radiation source room; or (c) entrances to the radiation source room where a person must, prior to entering the room, pass through a control area, provided that a radiation warning sign is placed at the outside entrance to the control area.
3.2.2	Illuminated radiation warning signs	<p>At each entrance through which entry to the radiation source room is possible, an illuminated radiation warning sign must be provided.</p> <p>This radiation warning sign light must be connected into the X-ray generator circuit in such a way that:</p> <ul style="list-style-type: none"> (a) it illuminates during both the preparation time and the full period of the X-ray exposure; and (b) it does not illuminate at any other time. <p>The radiation warning sign must contain words to the effect of ‘X-ray on’.</p> <p>Note: This requirement does not apply to:</p> <ul style="list-style-type: none"> (a) radiation source rooms in which the radiation apparatus is plain-film diagnostic X-ray equipment, mammography X-ray equipment, dental X-ray equipment or bone mineral densitometry X-ray equipment; or (b) radiation source rooms in which only a mobile radiation apparatus is used; or (c) rooms that can only be accessed from the radiation source room.
3.2.3	Communication with patients	<p>The operator must be able to observe and communicate with a patient during a radiation procedure.</p> <p>Note 1: This requirement does not apply to a radiation source room where only veterinary diagnostic radiography is carried out.</p> <p>Note 2: For the purposes of this test, ‘observe’ means to see a patient, either directly, or indirectly.</p>

3.3 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out radiation therapy (including veterinary radiation therapy)

Test	Compliance Test	Criteria for Passing the Test
3.3.1	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of ‘caution – X-rays’ <p>The symbol and lettering must be black on a yellow background.</p> <p>Note: This requirement does not apply to:</p> <ul style="list-style-type: none"> (a) rooms that can only be accessed from the radiation source room; or (b) entrances to the radiation source room where a person must, prior to entering the room, pass through a control area, provided that a radiation warning sign is placed at the outside entrance to the control area.
3.3.2	Illuminated radiation warning signs and audible warning devices	<p>The entrance to the radiation source room must have:</p> <ul style="list-style-type: none"> (a) a radiation warning sign which illuminates when the apparatus is in the preparatory state. This must contain words that indicate imminent radiation exposure (e.g. ‘ready’); and (b) a radiation warning sign which illuminates when the apparatus is in the loaded state. This must contain words that indicate radiation exposure (e.g. ‘beam-on’). <p>Within the radiation source room, radiation warning devices, both visible and audible, must be activated when the apparatus is in the preparatory state and the loaded state.</p> <p>Note: For this test:</p> <ul style="list-style-type: none"> (a) The warnings during each of the states must be clearly distinguishable from each other. (b) The visible devices must contain words to indicate the state of the apparatus. (c) The audible alarm must be a mechanism which allows the person to detect a change of circumstances audibly. (d) The radiation warning devices must either: <ul style="list-style-type: none"> (i) be fail safe (i.e. beam turns off if a device fails), or (ii) adequate warning that a device has failed must be indicated, at the control panel, in a clear and unambiguous manner.
3.3.3	Communication with patients	<p>The operator must be able to view and communicate with a patient during a radiation procedure.</p> <p>Note: This requirement does not apply to a radiation source room where only veterinary radiation therapy is carried out.</p>

Test	Compliance Test	Criteria for Passing the Test
3.3.4	Interlocks	<p>Each door required for radiation shielding must be interlocked to ensure that an exposure can not be made if the door is open.</p> <p>The entrance to the radiation source room must have an interlock that prevents exposure unless the interlock has been made.</p> <p>The breaking of an interlock during an exposure must automatically cause the beam to turn off and subsequent reinstatement of this interlock must not automatically turn the beam on.</p>
3.3.5	Last person out button	<p>There must be a ‘last person out’ interlocking arrangement composed of a button within the radiation source room and either:</p> <ul style="list-style-type: none"> (a) an entrance door interlock; or (b) a second button immediately outside the room. <p>The radiation apparatus must not be able to be activated unless the button within the room is pressed within a pre-defined period (of approximately 10 seconds) before the entrance door interlock is made or the button outside the room is pressed.</p> <p>The activation of the button within the radiation source room must be indicated by an audible signal.</p>
3.3.6	Rooms within radiation source rooms	<p>All doors to rooms within the radiation source room must be lockable in such a way that they prevent entry into the room from the radiation source room, but allow a person to exit the room.</p>
3.3.7	Emergency switch	<p>An emergency ‘off’ switch, which terminates an exposure, must be provided within the radiation source room.</p> <p>This switch must be conspicuous, clearly labelled and readily accessible to personnel within the radiation source room.</p>

3.4 Requirements, in addition to the principal requirement, for premises in which a radioactive substance is used to carry out high or pulsed dose rate brachytherapy using a remote afterloading brachytherapy machine

Test	Compliance Test	Criteria for Passing the Test
3.4.1	Radiation dose rate limit	In addition to the principal requirement for all premises, the dose rate measured at 30 centimetres from any accessible area or place external to the radiation source room must not exceed $10 \mu\text{Sv}\cdot\text{h}^{-1}$ as a result of the radiation practice being carried out in the radiation source room being assessed.
3.4.2	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of 'caution – radiation' <p>The symbol and lettering must be black on a yellow background.</p> <p>Note: This requirement does not apply to:</p> <ul style="list-style-type: none"> (a) rooms that can only be accessed from the radiation source room; or (b) entrances to the radiation source room where a person must, prior to entering the room, pass through a control area provided that a radiation warning sign is placed at the outside entrance to the control area.
3.4.3	Radiation survey meter and illuminated warning signs	<p>A fixed radiation survey meter must be provided to detect the radiation levels in the radiation source room.</p> <p>Each entrance to the radiation source room must have:</p> <ul style="list-style-type: none"> (a) a light, which is connected to the radiation survey meter, which illuminates when the radioactive substance is in its shielded position (b) a radiation warning sign, which is connected to the radiation survey meter, which illuminates when the radioactive substance is not in its shielded position. This must contain a radiation warning symbol (trefoil). <p>The visible devices must contain words to indicate the position of the radioactive substance.</p> <p>All illuminated warning signs or lights must be either:</p> <ul style="list-style-type: none"> (a) fail safe (i.e. returns the radioactive substance in its shielded position if the sign or light fails), or (b) adequate warning that the light has failed must be indicated in a clear and unambiguous manner.
3.4.4	Communication with patients	The operator must be able to view and communicate with a patient during a radiation procedure.
3.4.5	Interlocks	<p>Each door required for radiation shielding must be interlocked to ensure that the radioactive substance remains in its shielded position if the door is open.</p> <p>The entrance to the radiation source room must have an interlock to ensure that the radioactive substance remains in its shielded position if the door is open.</p>

Test	Compliance Test	Criteria for Passing the Test
		The breaking of an interlock during treatment must automatically cause the radioactive substance to return to its shielded position.
3.4.6	Last person out button	<p>There must be a 'last person out' button which is interlocked to ensure that the radioactive substance cannot be moved out of its shielded position unless the button has been pressed since the entrance interlock was last broken.</p> <p>The button must be located within the radiation source room. The activation of the button must be indicated by an audible signal.</p>
3.4.7	Rooms within irradiation rooms	The doors to rooms within radiation source rooms must be lockable in such a way that they prevent entry into the room from the radiation source room, but allow a person to exit the room.
3.4.8	Emergency switch	<p>An emergency 'off' switch, which terminates a treatment, must be provided within the radiation source room.</p> <p>This switch must be conspicuous, clearly labelled and readily accessible to personnel within the radiation source room.</p>

3.5 Requirements, in addition to the principal requirement, for premises in which an ionising radiation apparatus is used to carry out chemical analysis

Test	Compliance Test	Criteria for Passing the Test
3.5.1	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of ‘caution – X-rays’ <p>The symbol and lettering must be black on a yellow background.</p> <p>Note: This requirement does not apply to rooms that can only be accessed from the radiation source room.</p>
3.5.2	Illuminated radiation warning signs	<p>At each entrance through which entry to the radiation source room is possible, an illuminated radiation warning sign must be provided.</p> <p>This illuminated radiation warning sign must be connected into the X-ray generator circuit in such a way that:</p> <ol style="list-style-type: none"> (a) it illuminates when the X-ray tube is energised and which indicates that the radiation apparatus is operating; and (b) it does not illuminate at any other time. <p>A radiation warning sign combined with a light is also acceptable.</p> <p>The illuminated warning sign or light must be fail safe (ie. turns the beam off if the sign or light fails), or adequate warning that a sign or light has failed must be indicated in a clear and unambiguous manner.</p> <p>Note: This requirement does not apply to rooms that can only be accessed from the radiation source room.</p>
3.5.3	Notice displayed about hazards	<p>A clear and unambiguous notice must be displayed on or near the radiation apparatus indicating the hazards of operating the unit while barriers or shields are incomplete.</p> <p>Radiation apparatus which are enclosed by interlocked or fixed barriers and/or shields must have displayed on or near them a conspicuous notice which warns of the hazard of placing any part of the body, such as the hand, inside the barriers or shields.</p>

3.6 Requirements, in addition to the principal requirement, for premises in which a radiation source is used to carry out industrial gauging

Test	Compliance Test	Criteria for Passing the Test
3.6.1	Radiation warning signs	<p>A conspicuous radiation warning sign must be displayed adjacent to the industrial radiation gauge. This sign must be:</p> <ul style="list-style-type: none"> (a) made of material resistant to weather, dust and fumes likely to be present; and (b) clean, intact and in a legible condition; and (c) securely attached <p>This sign must contain the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • the word 'caution' or 'warning' • words to the effect of 'fixed radiation gauge containing radiation source' <p>The symbol and lettering must be black on a yellow background.</p>
3.6.2	Installation	The industrial radiation gauge must be securely fixed to the installation site.

3.7 Requirements, in addition to the principal requirement, for premises in which a radiation source is used to carry out industrial radiography

Test	Compliance Test	Criteria for Passing the Test
3.7.1	Radiation dose rate limit	In addition to the principal requirement for all premises, the dose rate measured at 30 centimetres from any accessible area or place external to the radiation source room must not exceed $25 \mu\text{Sv}\cdot\text{h}^{-1}$ as a result of the radiation practice being carried out in the radiation source room being assessed.
3.7.2	Radiation warning signs	Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information: <ul style="list-style-type: none"> radiation warning symbol (trefoil) words to the effect of 'warning - radiation area' <p>The word 'caution' is also acceptable.</p> <p>The symbol and lettering must be black on a yellow background.</p>
3.7.3	Warning signs	The radiation source room must be clearly identified as either a fully enclosed site or a partially enclosed site through the use of warning notices at access points.
3.7.4	Warning lights and audible warning devices	A warning light, which illuminates during exposure and is clearly visible from outside the radiation source room, must be provided at access points to the radiation source room.
3.7.5	Contact information displayed	The contact telephone number(s) of the radiation safety officer must be displayed either: <ol style="list-style-type: none"> at each entrance to the radiation source room; or in the radiation source room.
3.7.6	Operation via remote control	Radiation apparatus must be operable from outside the radiation source room by remote control.
3.7.7	Able to exit from within enclosure	An exit, which may be the main or only exit, must be provided to enable any person who is accidentally shut in to leave the radiation source room without delay.
3.7.8	Interlocks at access points	Where a maze is used for access of persons into the radiation source room, a lockable door or barrier must be provided and be interlocked.

Test	Compliance Test	Criteria for Passing the Test
		<p>(a) activate visible and audible alarms. Reinstatement of the interlock must not automatically reset the alarm; and</p> <p>(b) in the case of radiation apparatus, automatically cause the interruption of the power supply to the radiation apparatus. Subsequent closing of this interlocked door must not automatically re-energise the radiation apparatus.</p>
3.7.9	Enclosure requirements	<p>If the radiation source room is a fully enclosed site, when access doors or ports are closed, the walls, floor and ceiling of the site must form a completely shielded enclosure.</p> <p>If the radiation source room is a partially enclosed site, the shielded walls must be at least 2.1 metres high.</p>

3.8 Requirements, in addition to the principal requirement, for premises in which a machine source irradiator is used

Test	Compliance Test	Criteria for Passing the Test
3.8.1	Radiation dose rate limit	<p>In addition to principal requirement for all premises, the dose rate must not exceed:</p> <ul style="list-style-type: none"> (a) $4 \mu\text{Sv}\cdot\text{h}^{-1}$ in an area which is able to be accessed by members of the public or persons who are occupationally exposed but who are not involved in carrying out a radiation practice for the possession licensee at the premises; and (b) $200 \mu\text{Sv}\cdot\text{h}^{-1}$ averaged over any 100 square centimetres in an area normally only occupied by occupationally exposed persons involved in carrying out a radiation practice for the possession licensee at the premises; and (c) $0.5 \mu\text{Sv}\cdot\text{h}^{-1}$ in an area in the vicinity of the irradiator control console. <p>Note: For (a) and (b), the dose rate is to be measured at 30 centimetres from any accessible surface external to the radiation source room.</p>
3.8.2	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of 'warning: radiation area' <p>The word 'caution' is also acceptable.</p> <p>The symbol and lettering must be black on a yellow background.</p>
3.8.3	Visible warning signal	<p>A source status indicator (e.g. warning light) must be visible at each personnel or product entry and exit port in the radiation shield to indicate when the radiation source is energised.</p>
3.8.4	Radiation monitor	<p>A fixed radiation survey meter must be provided to detect the radiation levels in the radiation source room.</p> <p>The fixed radiation survey meter must be integrated with the personnel access door interlocks to prevent room access when the monitor:</p> <ul style="list-style-type: none"> • detects a radiation level in excess of $25 \mu\text{Gy}\cdot\text{h}^{-1}$; or • is turned off <p>The fixed radiation survey meter must generate visible and audible alarm signals if the radiation level exceeds $25 \mu\text{Gy}\cdot\text{h}^{-1}$ when the radiation source is indicated to be in the de-energised condition.</p>
3.8.5	Personnel access door interlocks	<p>The radiation source room personnel access door must be controlled using interlocks to prevent access when the radiation source is energised.</p> <p>The door interlocks must be integrated with the master control system such that violation of the interlock system or use of the door must cause the radiation source to return automatically to the de-energised condition.</p> <p>Opening of the door with the radiation source not in its de-energised condition, through malfunction or violation of any interlock, must generate visible and audible alarm signals.</p>

Test	Compliance Test	Criteria for Passing the Test
3.8.6	Safety delay timer	<p>The radiation source room must be equipped with a key operated safety timer that will automatically activate visible and audible warning signals to alert personnel in the area that the radiation source exposure sequence has commenced.</p> <p>The safety timer must be integrated with the master control system such that the radiation source cannot be energised unless the source exposure sequence is complete and the control console indicates that it is safe to energise the radiation source. The visible warning signal in the radiation source room must remain activated during irradiation.</p>
3.8.7	Emergency egress	It must be possible for personnel to leave the radiation source room at any time.
3.8.8	Emergency stop device in radiation source room	<p>An emergency stop device must be provided within the radiation source room to terminate irradiator operations and return the radiation source to the de-energised condition.</p> <p>The device must be conspicuous, clearly labelled and readily accessible to personnel in the radiation source room.</p>
3.8.9	Radiation source room shield plugs	Removable radiation source room shield plugs must be interlocked with the master control system to prevent or abort irradiator operations, causing the radiation source to return automatically to the de-energised condition if a plug is removed.
3.8.10	Gas control	The radiation source room must be designed to reduce the personal exposure to ozone and noxious gases to levels that do not exceed the requirements specified in Part 4 of the National Occupational Health and Safety Commission's <i>Adopted national exposure standards for atmospheric contaminants in the occupational environment</i> [NOHSC:1003(1995)]. ²
3.8.11	Power failure	If an electrical power failure occurs, the radiation apparatus must only be able to be re-energised by re-initiating the operating procedures.
3.8.12	Remotely located equipment	All remotely located equipment which could compromise personnel safety if misused, must be located in locked restricted areas.
3.8.13	Fire rating	The personnel access door must meet the requirements for an Australian Standard fire resistance level of thirty minutes, while retaining its integrity as a personnel access barrier.

² The document is available from the Australian Government - Australian Safety and Compensation Council's website: www.ascc.gov.au/ascc/HealthSafety/OHSstandards.

3.9 Requirements, in addition to the principal requirement, for premises in which a sealed source irradiator is used

Test	Compliance Test	Criteria for Passing the Test
3.9.1	Radiation dose rate limit	<p>In addition to principal requirement for all premises, the dose rate must not exceed:</p> <ul style="list-style-type: none"> (a) $4 \mu\text{Sv}\cdot\text{h}^{-1}$ in an area which is able to be accessed by members of the public or persons who are occupationally exposed but who are not involved in carrying out a radiation practice for the possession licensee at the premises; and (b) $200 \mu\text{Sv}\cdot\text{h}^{-1}$ averaged over any 100 square centimetres in an area normally only occupied by occupationally exposed persons involved in carrying out a radiation practice for the possession licensee at the premises; and (c) $0.5 \mu\text{Sv}\cdot\text{h}^{-1}$ in an area in the vicinity of the irradiator control console. <p>Note: For (a) and (b), the dose rate is to be measured at 30 centimetres from any accessible surface external to the radiation source room.</p>
3.9.2	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of ‘warning: radiation area’ <p>The word ‘caution’ is also acceptable.</p> <p>The symbol and lettering must be black on a yellow background.</p>
3.9.3	Visible warning signal	<p>A source status indicator (e.g. warning light) must be visible at each personnel or product entry and exit port in the radiation shield to indicate when the radiation source is not fully shielded.</p>
3.9.4	Audible warning signal	<p>A warning signal, which is audible both inside the radiation source room and at all access ports, must be provided to indicate when the radiation source is not fully shielded.</p>
3.9.5	Radiation survey meter	<p>A fixed radiation survey meter must be provided to detect the radiation levels in the radiation source room.</p> <p>The fixed radiation survey meter must be integrated with the personnel access door interlocks to prevent room access when the monitor:</p> <ul style="list-style-type: none"> • detects a radiation level in excess of $25 \mu\text{Gy}\cdot\text{h}^{-1}$; or • is turned off <p>The fixed radiation survey meter must generate visible and audible alarm signals if the radiation level exceeds $25 \mu\text{Gy}\cdot\text{h}^{-1}$ when the radiation source is indicated to be in the fully shielded condition.</p>
3.9.6	Personnel access door interlocks	<p>The radiation source room personnel access door must be closed or secured before the source can be energized. This door must be interlocked.</p> <p>The door interlocks must be integrated with the master control system such that violation of the interlock system or use of the door must cause the radiation source to return automatically to the fully shielded condition.</p>

Test	Compliance Test	Criteria for Passing the Test
		Opening of the door with the radiation source not in its fully shielded condition, through malfunction or violation of any interlock, must generate visible and audible alarm signals.
3.9.7	Safety timer	<p>The radiation source room must be equipped with a key operated safety timer that will automatically activate visible and audible warning signals to alert personnel in the area that the radiation source exposure sequence has commenced.</p> <p>The safety timer must be integrated with the master control system such that the radiation source cannot be exposed unless the source exposure sequence is complete and the control console indicates that it is safe to expose the radiation source. The visible warning signal in the radiation source room must remain activated during irradiation.</p>
3.9.8	Emergency egress	It must be possible for personnel to leave the radiation source room at any time.
3.9.9	Emergency stop device in radiation source room	<p>An emergency stop device must be provided within the radiation source room to terminate irradiator operations and return the radiation source to the fully shielded condition.</p> <p>The device must be conspicuous, clearly labelled and readily accessible to personnel in the radiation source room.</p>
3.9.10	Exit ports	<p>Duplicate fixed radiation survey meters with an audible alarm must be located such that they may detect radiation emitted through the product exit port.</p> <p>This monitoring system must be interlocked with the irradiator controls such that if the radiation level at the exit port exceeds a predetermined level, the conveyor which carries product from the radiation source room to the exit port must stop and the radiation source must return automatically to the fully shielded position.</p>
3.9.11	Radiation source room shield plugs	Removable radiation source room shield plugs must be interlocked with the master control system to prevent or abort irradiator operations, causing the radiation source to return automatically to the fully shielded condition if a plug is removed.
3.9.12	Fire protection	<p>(a) Heat and smoke sensing devices with visible and audible alarms must be provided to detect combustion in the radiation source room.</p> <p>An interlock must be provided which will ensure the radiation source will return automatically to the fully shielded position and the product positioning and any ventilation systems must shut down if either device is actuated.</p> <p>(b) A fire extinguishing system must be provided in the radiation source room, and adjoining spaces.</p>
3.9.13	Gas control	The radiation source room must be designed to reduce the personal exposure to ozone and noxious gases to levels that do not exceed the requirements specified in Part 4 of the National Occupational Health and Safety Commission's <i>Adopted national exposure standards for atmospheric contaminants in the occupational environment</i> [NOHSC:1003(1995)]. ³

³ The document is available from the Australian Government - Australian Safety and Compensation Council's website: www.ascc.gov.au/ascc/HealthSafety/OHSstandards.

Test	Compliance Test	Criteria for Passing the Test
3.9.14	Power failure	<p>If an electrical power failure of more than ten seconds occurs, the radiation sources must return automatically to the fully shielded position and the irradiator must shut down.</p> <p>Failure of non-electrical power, such as pneumatic or hydraulic, which is used to control or operate any irradiator safety feature or device must cause the source to return automatically to the fully shielded position and the irradiator to shut down.</p>
3.9.15	Remotely located equipment	All remotely located equipment, such as radiation source hoists on radiation room roofs, which could compromise personnel safety if misused, must be located in locked restricted areas.
3.9.16	Fire rating	The personnel access door must meet the requirements for an Australian Standard fire resistance level of thirty minutes, while retaining its integrity as a personnel access barrier.
3.9.17	Pool guard	A physical barrier must be placed around any open pool to prevent personnel from inadvertently falling into the storage pool.
3.9.18	Pool integrity	There must be no penetration (eg. by pipes or plugged holes) through the bottom of the pool. There must be no penetration through the walls of the pool more than 30 centimetres below normal water level.
3.9.19	Pool water controls	<p>A metering device must be installed in the replenishment water supply line.</p> <p>Means must be provided to replenish water losses from the pool automatically.</p>
3.9.20	Pool water level alarm	<p>Means must be provided to activate audible and visible signals in the control area if the pool water falls abnormally to the level more than 30 centimetres below the normal water level.</p> <p>It must not be possible to enter the radiation source room using normal entry procedures while the abnormal, low water level condition exists.</p>
3.9.21	In-pool piping	<p>Suitable syphon breakers must be provided to prevent the syphoning of pool water (e.g. for water level and water quality systems) lower than 30 centimetres below the normal level.</p> <p>All pool water circulation suction pipes must have intakes no lower than 30 centimetres below the normal level.</p>
3.9.22	Water conditioning	The pool must be equipped with a system capable of maintaining the water in a clean condition and at a level of conductance not exceeding 1000 microsiemen per metre.
3.9.23	Cleaning storage pool	Any vacuum system used for pool cleaning must be fitted with an in-line filter.

3.10 Requirements, in addition to the principal requirement, for premises in which a radiation source is used as part of a nuclear medicine practice

Test	Compliance Test	Criteria for Passing the Test
3.10.1	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil); and • words to the effect of ‘warning – radiation area’ <p>The word ‘caution’ is also acceptable.</p> <p>The symbol and lettering must be black on a yellow background.</p>
3.10.2	Illuminated radiation warning signs	<p>If a radiation apparatus is used, at each entrance through which entry to the apparatus is possible, an illuminated radiation warning sign must be provided.</p> <p>This radiation warning sign light must be connected into the X-ray generator circuit in such a way that:</p> <ol style="list-style-type: none"> (a) it illuminates during both the preparation time and the full period of the X-ray exposure; and (b) it does not illuminate at any other time. <p>The radiation warning sign must contain words to the effect of ‘X-ray on’.</p> <p>Note: This requirement does not apply if:</p> <ol style="list-style-type: none"> (a) the radiation apparatus is plain-film diagnostic X-ray equipment, mammography X-ray equipment, dental X-ray equipment or bone mineral densitometry X-ray equipment; or (b) only a mobile radiation apparatus is used
3.10.3	Communication with patients	<p>If a radiation apparatus is used in the radiation source room, the operator must be able to observe and communicate with a patient during a radiation procedure.</p> <p>Note: For the purposes of this test, ‘observe’ means to see a patient, either directly, or indirectly.</p>
3.10.4	Contact information displayed	<p>The contact telephone number(s) of the radiation safety officer must be displayed at conspicuous locations within the radiation source room.</p>
3.10.5	Surface finishes	<p><i>Low level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room within the radiation source room:</p> <ol style="list-style-type: none"> (a) fittings and finishes must be readily cleanable; and (b) joints must be sealed and waterproof and must be located away from sources of contamination; and (c) the floor must be a sealed surface that is readily cleanable. <p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room within the radiation source room:</p>

Test	Compliance Test	Criteria for Passing the Test
		<p>(a) fittings and finishes must be readily cleanable; and</p> <p>(b) joints must be sealed and waterproof and must be located away from sources of contamination; and</p> <p>(c) the floor covering must be covered up to, and be sealed to, walls and fixed vertical surfaces.</p>
3.10.6	Benches	<p><i>Low level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room within the radiation source room, benchtops must have a smooth, waterproof, chemically resistant covering which is readily cleanable.</p> <p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room within the radiation source room:</p> <p>(a) benchtops must have a smooth, waterproof, chemically resistant covering which is readily cleanable; and</p> <p>(b) joints between bench surfaces must be designed and constructed so that they do not leak or trap contamination.</p>
3.10.7	Hand basins	<p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room within the radiation source room, a handbasin must be provided in the radiation source room and the taps must be able to be operated automatically, or by wrist, knee or foot.</p>
3.10.8	Drainage systems	<p>If unsealed radioactive substances are used for inpatient therapeutic purposes within the licensee's premises, the drainage system must be labelled at accessible locations within the premises with the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of 'caution – possible radiation: contact the Radiation Safety Officer'
3.10.9	Ventilation	<p><i>Medium level radioisotope laboratory</i></p> <p>Where radioactive material is likely to emit a radioactive gas, a fume cupboard must be installed in the room. The fume cupboard exhaust air must not be recirculated.</p> <p>Alternatively, if a fume cupboard is not installed:</p> <p>(a) the room must be maintained at a negative pressure with respect to adjacent spaces; and</p> <p>(b) an alarm system which is automatically activated in the event of failure of the ventilation system must be installed; and</p> <p>(c) The minimum outdoor fresh air flow rate per unit of total floor area must be 6 – 9 litres per second per square metre of total floor area.</p> <p><i>High level radioisotope laboratory</i></p> <p>Where radioactive material is likely to emit a radioactive gas, a fume cupboard</p>

Test	Compliance Test	Criteria for Passing the Test
		<p>must be installed in the room. The fume cupboard exhaust air must not be recirculated.</p> <p>Alternatively, if a fume cupboard is not installed:</p> <ul style="list-style-type: none"> (a) the room must be maintained at a negative pressure with respect to adjacent spaces; and (b) an alarm system which is automatically activated in the event of failure of the ventilation system must be installed; and (c) the minimum outdoor fresh air flow rate per unit of total floor area must be at least 9 litres per second per square metre of total floor area; and (d) windows in the radiation source room must be of fixed glass and non-openable.
3.10.10	Change room	<p><i>High level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used in an area or room in the radiation source room, a change room must be located at the entrance to the room.</p>
3.10.11	Security	<p>The hardware required to prevent access by unauthorised persons must be installed.</p>

3.11 Requirements, in addition to the principal requirement, for all premises not listed in 3.1 to 3.10 in which radioactive substances are used (including veterinary radiotherapy)

Test	Compliance Test	Criteria for Passing the Test
3.11.1	Radiation warning signs	<p>Each entrance to the radiation source room must display a conspicuous radiation warning sign which contains the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of ‘warning: radiation area’ <p>The word ‘caution’ is also acceptable.</p> <p>The symbol and lettering must be black on a yellow background.</p>
3.11.2	Contact information displayed	<p>The contact telephone number(s) of the radiation safety officer must be displayed either:</p> <ul style="list-style-type: none"> (a) at each entrance to the radiation source room; or (b) in the radiation source room.
3.11.3	Surface finishes	<p><i>Low level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used:</p> <ul style="list-style-type: none"> (a) fittings and finishes must be readily cleanable; and (b) joints must be sealed and waterproof and must be located away from sources of contamination; and (c) the floor must be a sealed surface that is readily cleanable. <p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used:</p> <ul style="list-style-type: none"> (a) fittings and finishes must be readily cleanable; and (b) joints must be sealed and waterproof and must be located away from sources of contamination; and (c) the floor covering must be covered up to, and be sealed to, walls and fixed vertical surfaces.
3.11.4	Benches	<p><i>Low level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used, benchtops must have a smooth, waterproof, chemically resistant covering which is readily cleanable.</p> <p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used:</p> <ul style="list-style-type: none"> (a) benchtops must have a smooth, waterproof, chemically resistant covering which is readily cleanable; and (b) joins between bench surfaces must be designed and constructed so that they do not leak or trap contamination.

Test	Compliance Test	Criteria for Passing the Test
3.11.5	Hand basins	<p><i>Medium and high level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used, a handbasin must be provided in the radiation source room and the taps must be able to be operated automatically, or by wrist, knee or foot.</p>
3.11.6	Drainage systems	<p>If unsealed radioactive substances are used within the licensee's premises, the drainage system must be labelled at accessible locations within the premises with the following information:</p> <ul style="list-style-type: none"> • radiation warning symbol (trefoil) • words to the effect of 'caution – possible radiation: contact the Radiation Safety Officer'
3.11.7	Ventilation	<p><i>Medium level radioisotope laboratory</i></p> <p>Where radioactive material is likely to emit a radioactive gas, a fume cupboard must be installed in the radiation source room. The fume cupboard exhaust air must not be recirculated.</p> <p>Alternatively, if a fume cupboard is not installed:</p> <ol style="list-style-type: none"> (a) the radiation source room must be maintained at a negative pressure with respect to adjacent spaces; and (b) an alarm system which is automatically activated in the event of failure of the ventilation system must be installed; and (c) The minimum outdoor fresh air flow rate per unit of total floor area must be 6 – 9 litres per second per square metre of total floor area. <p><i>High level radioisotope laboratory</i></p> <p>Where radioactive material is likely to emit a radioactive gas, a fume cupboard must be installed in the radiation source room. The fume cupboard exhaust air must not be recirculated.</p> <p>Alternatively, if a fume cupboard is not installed:</p> <ol style="list-style-type: none"> (a) the radiation source room must be maintained at a negative pressure with respect to adjacent spaces; and (b) an alarm system which is automatically activated in the event of failure of the ventilation system must be installed; and (c) the minimum outdoor fresh air flow rate per unit of total floor area must be at least 9 litres per second per square metre of total floor area; and (d) windows in the radiation source room must be of fixed glass and non-openable.
3.11.8	Change room	<p><i>High level radioisotope laboratory</i></p> <p>If unsealed radioactive substances are used, a change room must be located at the entrance to the radiation source room.</p>
3.11.9	Security	<p>The hardware required to prevent access by unauthorised persons must be installed.</p>