Code of Practice for Radiological Protection in Dentistry

Prepared by the Radiological Protection Institute of Ireland
in consultation with the Department of Health
and the Dental Council
(revised March 1996)
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Errata

Page 8

Delete:

European Communities (Medical Ionising Radiation) Regulations, 1988 (S.I. No. 189 of 1988) which implements the EC Directive on the protection of the patient undergoing medical examination or treatment (84/466/Euratom). These regulations refer to the need for specialised training of all doctors/dentists who use or direct the use of ionising radiation for medical/dental purposes.

European Communities (Ionising Radiation) Regulations, 1991 (S.I. No. 43 of 1991) which implements, in this country, the EC Directive on the protection of the general public and workers against the dangers of ionising radiation (80/836/Euratom of 15 July 1980 as amended by 84/467/Euratom of 3 September 1984). In particular these regulations, stipulate dose limits for both occupational and public exposure, require the notification and reporting of activities involving ionising radiation and define what constitutes offences under the said regulations.

Radiological Protection Act, 1991 (General Control of Radioactive Substances Nuclear Devices and Irradiating Apparatus) Order, 1993 (S.I. No. 151 of 1993) under which activities involving exposure to ionising radiation are prohibited save under a licence issued by the RPII.


Insert:


European Communities (Medical Ionising Radiation) Regulations, 2002 (S.I. No. 478 of 2002), as amended, which implements the EC Directive on the protection of the patient undergoing medical examination or treatment (97/43/Euratom). These regulations refer to the need for specialised training of all doctors/dentists who use or direct the use of ionising radiation for medical/dental purposes.

Delete:

(i) A licence must be obtained from the RPII for radioactive substances and irradiating apparatus (including dental X-ray units) in accordance with the requirements specified in S.I. No. 151 of 1993.

(ii) From the regulations set out in S.I. No. 43 of 1991, it can be seen that all medical exposures must be clinically justified and the need to keep exposures as low as is reasonably achievable is emphasised. Strict limits on doses to workers and members of the public are laid down. (See Tables 1 and 2).

Insert:

(i) A licence must be obtained from the RPII for radioactive substances and irradiating apparatus (including dental X-ray units) in accordance with the requirements specified in S.I. No. 125 of 2000. Strict limits on doses to workers and members of the public are laid down in this statutory instrument (See Table 1).

(ii) From the regulations set out in S.I. No. 478 of 2002, it can be seen that all medical exposures must be clinically justified and the need to keep exposures as low as is reasonably achievable is emphasised.
TABLE 1

ANNUAL DOSE LIMITS FOR OCCUPATIONALLY EXPOSED PERSONS

<table>
<thead>
<tr>
<th></th>
<th>Dose Limit</th>
<th>Dose Constraint*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Dose</td>
<td>20 mSv</td>
<td>5 mSv</td>
</tr>
<tr>
<td>Lens of the eye</td>
<td>150 mSv</td>
<td>5 mSv</td>
</tr>
<tr>
<td>Hands &amp; feet</td>
<td>500 mSv</td>
<td>50 mSv</td>
</tr>
<tr>
<td>Skin</td>
<td>500 mSv</td>
<td>50 mSv</td>
</tr>
</tbody>
</table>

* Most applications of ionising radiation in Ireland, including its use in dentistry, are such that annual doses received by occupationally exposed persons should be well below the annual dose limit of 20 mSv. Accordingly, the Institute requires dentists to constrain doses to occupationally exposed persons to those in column 3 of the table above. Furthermore, dentists should carry out an investigation of any practice which in any 8 week period gives rise to a dose in excess of 1 mSv. In this way, problems with the use of X-ray units and the radiological protection of personnel can be detected at a relatively early stage of development.

TABLE 2

ANNUAL DOSE LIMITS FOR NON-OCCUPATIONALLY EXPOSED PERSONS

<table>
<thead>
<tr>
<th></th>
<th>Dose Limit</th>
<th>Dose Constraint*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Dose</td>
<td>1 mSv</td>
<td>0.05 mSv</td>
</tr>
<tr>
<td>Lens of the eye</td>
<td>15 mSv</td>
<td>0.05 mSv</td>
</tr>
<tr>
<td>Skin</td>
<td>50 mSv</td>
<td>0.05 mSv</td>
</tr>
</tbody>
</table>

* The value of 0.05 mSv applies to the “public at large” that is persons who have no involvement with the clinic – e.g. persons living in an adjacent dwelling house. In the case of the public who are in the employ of the dentists or dental clinic, but not as exposed workers, a figure of 0.5 mSv per year shall apply.
TABLE 1

ANNUAL EFFECTIVE DOSE LIMITS AND CONSTRAINTS

<table>
<thead>
<tr>
<th></th>
<th>Dose Limit</th>
<th>Dose Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed worker</td>
<td>20 mSv</td>
<td>1.0 mSv</td>
</tr>
<tr>
<td>All others</td>
<td>1 mSv</td>
<td>0.3 mSv</td>
</tr>
</tbody>
</table>

Most applications of ionising radiation in Ireland, including its use in dentistry, are such that annual doses received by occupationally exposed persons should be well below the annual dose limit of 20 mSv. Accordingly, the Institute requires dentists to constrain doses to occupationally exposed persons to those in column 3 of the table above. Furthermore, dentists should carry out an investigation of any practice which in any 8 week period gives rise to a dose in excess of 1 mSv. In this way, problems with the use of X-ray units and the radiological protection of personnel can be detected at a relatively early stage of development.

The value of 0.3 mSv applies to the “public at large” that is persons who have no involvement with the clinic – e.g. persons living in an adjacent dwelling house. In the case of the public who are in the employ of the dentist or dental clinic, but not as exposed workers, the figure of 0.3 mSv per year shall also apply.

September 2009
Code of Practice for Radiological Protection in Dentistry

Prepared by the Radiological Protection Institute of Ireland
in consultation with the Department of Health
and the Dental Council
(revised March 1996)
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Explanatory Note

This Code of Practice supersedes the Code, with the same title, published in 1988. The Code has been prepared for publication by the Radiological Protection Institute of Ireland in consultation with the Department of Health and the Dental Council. The Institute would like to express its gratitude to the representatives of these bodies who have assisted in the drafting.

The words "shall", "must" and "should" in this Code have been chosen with purpose. The words "shall" or "must" indicate a mandatory requirement, while "should" indicates an advisory recommendation that is highly desirable and that is to be implemented where feasible. Furthermore since it is a condition of licence that this Code be upheld, the Radiological Protection Institute of Ireland (RPII) will not issue a licence where it believes that a mandatory requirement will not or cannot be met. In this regard attention is drawn to section 6 of this Code of Practice which indicates that there are certain equipment standards, which were previously considered desirable, but which are mandatory since 1st January 1995. Dentists who are in the process of selecting new equipment should ensure that it meets these standards, if it is to be acceptable for licensing.

Use of the term "dentist" in this Code of Practice means a person registered in the Register of Dentists maintained by the Dental Council under the provisions of the Dentists Act, 1985.
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1. **Need for Radiological Protection**

This Code of Practice deals with the use of X-rays in dentistry. There are two kinds of biological consequences which result from the radiation exposure of humans:

- *Somatic effects* which affect the individual exposed;

- *Genetic effects* which affect the progeny of irradiated persons.

*Somatic Effects* are further divided into two types:

**Deterministic Effects**

These are effects which include, among others, the induction of cataract of the lens of the eye and skin erythema. They would not be expected to occur for exposures below a threshold value. The severity of the effect is assumed to be proportional to the dose received.

**Stochastic Effects**

These are effects which include the induction of leukaemia and some other cancers. The probability of occurrence is assumed to be proportional to the dose received with no threshold value below which no effects will be observed.

Dental radiography can give rise to a significant dose of radiation to the bone marrow in the skull and cervical spine, the oral mucosa, the thyroid and the eye as well as to any part of any person exposed to the primary beam.

The utilisation of badly adjusted equipment, and/or a poor technique (e.g. holding an X-ray film in the hand) may unnecessarily increase the incidence of stochastic effects and could in some extreme cases give rise to the induction of a deterministic effect.

**Genetic Effects**

Owing to the rapid growth in the use of dental X-rays and the increasing number of persons undergoing dental examinations the genetic effects of ionising radiation from dental radiography may also be of concern.

It is important to remember that the number and variety of radiation sources contributing to the total exposure of the public is increasing. No user or group of users of ionising radiation has the right to defend its position simply on the basis that, in comparison with others, it is producing only a small population exposure. The largest single contributor of man-made radiation exposure to the population is medical and dental diagnostic radiology. It is assumed that, for the purpose of
establishing acceptable standards of protection from ionising radiation, any exposure, no matter how small, carries some risk. The magnitude of this risk is also assumed to be proportional to the magnitude of the dose received. Radiographic procedures which minimise the dose to patients and at the same time yield the required diagnostic information must, therefore, be utilised. All users of radiation must take every practical step to minimise the exposures for which they are responsible.

2. Statutory Controls

The principal legal documents which apply to the control of sources of ionising radiation in Ireland are:

The **Radiological Protection Act, 1991** (No. 9 of 1991) establishing the Radiological Protection Institute of Ireland (RPII).

**European Communities (Medical Ionising Radiation) Regulations, 1988** (S.I. No. 189 of 1988) which implements the EC Directive on the protection of the patient undergoing medical examination or treatment (84/466/Euratom). These regulations refer to the need for specialised training of all doctors/dentists who use or direct the use of ionising radiation for medical/dental purposes.

**European Communities (Ionising Radiation) Regulations, 1991** (S.I. No. 43 of 1991) which implements, in this country, the EC Directives on the protection of the general public and workers against the dangers of ionising radiation (80/836/Euratom of 15 July 1980 as amended by 84/467/Euratom of 3 September 1984). In particular these regulations, stipulate dose limits for both occupational and public exposure, require the notification and reporting of activities involving ionising radiation and define what constitutes offences under the said regulations.

**Radiological Protection Act, 1991 (General Control of Radioactive Substances, Nuclear Devices and Irradiating Apparatus) Order, 1993** (S.I. No. 151 of 1993) under which activities involving exposure to ionising radiation are prohibited save under licence issued by the RPII.


In addition, the Minister for Health has powers under the **Health Act, 1953** (No. 26 of 1953) to make regulations for the control of the use, etc. of radioactive substances and irradiating apparatus in the medical and dental areas.

The RPII's regulatory policy is also designed to reflect the most recent **1990 Recommendations of the International Commission on Radiological Protection** [ICRP, 1991].
3. **Implications for the Practice of Dentistry**

The following are the major implications of the above legislation for the practice of dentistry in this country:

(i) A licence for the custody of dental radiographic equipment must be obtained from the RPII. This should be applied for at least 28 days before starting work with equipment. The Dental Council informs all new entrants to the Dental Register of these requirements.

Any change in the type and use of equipment, ownership or address at which it is used shall be notified to the RPII.

(ii) All radiographic exposures shall be clinically justified and kept as low as reasonably achievable and planning of exposures should be carried out with due regard to the measures outlined in this Code.

(iii) In each practice a named dentist who is appropriately trained is required to take day-to-day responsibility for radiological protection. It will be the responsibility of this person to see that the Code is adhered to and that any staff who are involved in work with radiographic equipment are properly trained and any female staff employed in the practice are made aware of the possible hazards of ionising radiation during pregnancy.

(iv) The dentist must ensure that all radiographic equipment under his/her responsibility conforms to the standards outlined in this Code.

(v) The inspection of dental surgeries may be undertaken by the RPII to ascertain if adequate radiological protection measures are being taken.

(vi) If the workload is high i.e. over 350 intra-oral or 40 panoramic films per week, or when using cephalometric techniques then the possible use of protective barriers and structural shielding of installations must be evaluated.

4. **Training**

Radiographic equipment may only be used under the direction and supervision of dentists who have had adequate training in radiological protection and radiographic techniques as approved by the Dental Council. Persons other than dentists may operate dental radiographic equipment only under the direction and supervision of a dentist, as described in Section 3 (iii) above and if they have followed a course of training in radiation protection and radiographic techniques approved by the Dental Council. Persons, other than dentists, assisting in carrying out dental radiographic procedures must have received instruction and
training in radiological protection measures as appropriate to their work: it is the responsibility of the licensee to ensure that this training is provided.

5. Responsibility for Radiological Protection

a) Private Practice

The dentist is the person responsible for all aspects of radiological protection in private dental practice. Where more than one dentist is in the practice then a particular dentist shall be given this responsibility. The dentist with responsibility for radiological protection is referred to as the Radiological Protection Officer (RPO).

It is the RPO's responsibility to ensure that the dental facility complies with the safety requirements outlined in this Code, and that radiographic equipment works satisfactorily and is operated only by trained personnel. The RPO shall also establish procedures so that this Code is applied by the staff. Where necessary, for example when sophisticated equipment such as an orthopantomographic unit is being used, the RPO shall consult with a qualified in radiological physics, when exercising these responsibilities.

The dentist must hold a licence for the custody and use of all radiographic equipment for which he/she is responsible.

b) Health Board and Hospital Based Equipment

Ultimate responsibility for ensuring the licensing of radiographic equipment and for radiological protection in Health Board facilities, in hospitals (including dental hospitals) and other institutions rests with the employing authority. In the case of equipment located in a Health Board the principal dental surgeon of each administrative area shall be appointed to act as RPO for that area. One of the RPO's shall also be nominated to act as RPII contact person. The contact person shall communicate with the Institute in regard to such matters as reporting of accidents and incidents, renewal of and amendments to the licence and the implementation of repairs and improvements which the Institute may call for following an inspection.

In each health centre with dental radiographic facilities a named dentist shall be nominated to act as Radiological Safety Officer. These Safety Officers, shall assist the RPO in carrying out his/her responsibilities.

Health Boards and other bodies which hold dental X-ray equipment must hold a licence from the RPII for its custody and use.
Health Boards and other institutions shall also establish or be party to administrative structures including a Radiation Safety Committee. This committee shall provide advice on all aspects of radiological protection in dentistry.

This committee, may be one and the same body as that which has responsibility for general medical radiation safety or, where considered more appropriate, a separate entity. Membership of the committee should include the principal dental surgeons in each administrative area, a radiologist, radiological protection advisor (who shall be a qualified expert in radiological physics), medical officer and representatives of both management and clinical staff.

6. Radiographic Equipment

All X-ray apparatus shall be maintained, serviced and have its performance checked annually by suitably qualified and competent persons.

A full Quality Assurance inspection to insure compliance with Appendix 2 as well as an assessment of electrical and mechanical safety shall be carried out on all new equipment, and every two years thereafter, by a competent expert. The expert shall be independent of the supplying company. The frequency of inspection may be altered with expert advice. Particular attention shall be paid to old equipment.

It should be noted that the following equipment features are mandatory since 1st January 1995.

1. An electronic timer which is capable of terminating an exposure at a pre-set time (max. 5 seconds).

2. Voltage 'mains on' and 'exposure' warning lights to be fitted on the control panel.

While the lower limit for kilovoltage shall remain 50 kVp, for all units purchased since 1st January 1995, the kilovoltage shall be in the range 60-75 kVp.

The user shall keep a record of the dates and results of all checks and servicing. The RPII may require objective evidence that performance checks and servicing have been carried out before issuing or renewing a licence.

7. Location of Equipment

The equipment may be located in the dental surgery or a separate room. There shall be sufficient space and the exposure switch cable shall be long enough to allow the operator and staff to maintain a distance of at least 2 m from the tube head. In the case of pantomographic or cephalometric equipment, the unit should be operated from behind a protection screen or wall. Access to the room shall be limited during a radiographic exposure.
8. **Film Processing and Storage**

It is essential that meticulous attention shall be given to processing techniques and the proper use of developing and fixing solutions in order that repeat X-ray examinations are not necessary. Manufacturer's recommendations with respect to strength of solutions, temperature and time must be followed to ensure optimum development. Solutions should be replenished or replaced as necessary. Even unused developer deteriorates with time. It is important to note that chemicals and films have limited shelf lives and must not be used after the manufacturer's specified expiry dates.

Cleanliness is important to reduce film artefacts for both manual and automatic film processing. Automatic film processors shall be cleaned, serviced and have the quality of performance assessed in accordance with the manufacturer's recommendations.

Storage and processing facilities shall be designed and located so that films are not exposed to more than 2 µGy prior to development. A dark room shall be well blacked out to prevent fogging of films and the safe light equipped with an appropriate filter. The film storage container shall be adequately shielded to prevent exposure of films and should be kept in cool and dry conditions (10 - 20°C).

9. **Procedures to Minimise Doses to Patients**

(i) Only those X-rays which, after a clinical examination and a careful consideration of both the dental and general health needs of the patient, are found to be necessary for patient care shall be carried out. The routine use of X-rays without a specific dental or associated need is not warranted. It shall be determined if there are any previous X-ray examinations which would make further examination unnecessary.

(ii) The operator shall use the minimum exposure time consistent with obtaining a good quality film. This includes using the fastest film which will give the necessary contrast and detail and with extraoral films the use of cassettes with intensifying screens.

(iii) Unnecessary repeat films shall be avoided by using a proper technique and reliable and consistent processing.

(iv) Film holders and bitewing films should be used to save the patient having to hold the film.

(v) As it is difficult to differentiate between categories of patient at particular risk from radiation, a protective lead apron, preferably with a thyroid collar, should be worn by all patients having X-ray examinations, but shall by worn by patients when taking vertex occlusal films. In panoramic radiography, since the source of the radiation is
coming from the back of the patient, dual (front and back) lead aprons should be used.

(vi) Particular care should be taken with women who may be or are pregnant. A protective apron shall be provided to protect the foetus.

(vii) Clinical records shall include details of all X-ray examinations carried out.

10. **Operator and Staff Protection**

(i) The operator and other staff shall not stand in the direct beam during exposure nor shall they hold the tube housing or the cone.

(ii) The dental film, wherever possible, should be fixed in position, otherwise it should be held by the patient. The dental practitioner or other personnel shall not hold the film in place during exposure.

(iii) The operator and other staff shall stand at least two metres away from the tube head and patient during exposure and only those people whose presence is essential should remain in the X-ray room during exposure.

(iv) The operator should stand behind a protective barrier with a lead equivalent of not less than 0.5 mm if the workload is high i.e. above 350 intra-oral or 40 panoramic films per week or when using cephalometric techniques.

(v) If persons are needed to assist children or weak patients they shall avoid the direct beam and must be provided with a lead apron. The same person must not regularly perform these duties.

(vi) Checks shall be made of doses received by staff. Monitoring badges shall be worn continuously by all staff involved in work with ionising radiation. Badges shall be worn on the trunk between the level of the shoulders and the hips, and changed every eight weeks. The above arrangement shall not apply to pregnant staff who should wear the badges over the abdomen and have them changed fortnightly during the 8-15 week period of the pregnancy and monthly for the remainder of their pregnancy. Alternatively, it may prove more convenient to change the badge fortnightly from the date of declaration of pregnancy until the woman goes on maternity leave.

All monitoring badges shall be obtained from the Dosimetry Service of the RPII, or from another laboratory approved by the Institute and returned thereto for examination. Records of doses received by staff shall be kept by the licensee.

(vii) It is the dentist's responsibility to see that all members of staff involved in work with ionising radiation receive information about, and training in, the radiological
protection measures outlined here. Special attention should be applied to the protection of women of childbearing age and of pregnant women. It is the duty of the dentist to inform any such employee in his/her practice of the possible hazards to the foetus from ionising radiation. A protective lead apron must be worn by pregnant women operating or assisting in radiographic procedures.

(viii) An X-ray room shall not be used simultaneously for more than one radiological investigation.

11. Protection of the Public

(i) The direct beam shall not be directed through doors or windows or wooden floors behind which persons may be situated. Normally, the direct beam will be restricted to certain main directions and the locations to which the beam is directed shall have adequate thickness of absorbing materials, i.e. brick or concrete, in order to protect persons working or living in adjacent locations.

(ii) Normally, only small levels of scattered radiation are detectable on the inner walls of dental surgeries. There is therefore no need for heavy structural shielding to protect from scattered radiation. However, if the workload is high, i.e. more than 350 intra-oral or 40 panoramic films per week or when using cephalometric techniques, and depending on factors such as the maximum voltage of the machine and the distance from the source of radiation, the installation of structural shielding may be necessary. Advice may be obtained from the RPII or the Radiation Safety Committee where appropriate.

12. Accidents

Any accident involving exposure or suspected exposure to ionising radiation must be reported as soon as possible (and within 48 hours) by the dentist or employing authority to the RPII and the Radiation Safety Committee where one exists.

13. References

14. Additional Information

Further advice and information on radiological protection are available from the Regulatory Service of the RPII. Queries should be addressed to:

Radiological Protection Institute of Ireland
3 Clonskeagh Square
Clonskeagh Road
Dublin 14.

Copies of the relevant legal documents are available from:

Government Publications Sale Office
Sun Alliance House
Molesworth Street
Dublin 2.
APPENDIX 1

Summary of Requirements of Legislation
Governing the Control of Sources of Ionising Radiation

(i) A licence must be obtained from the RPII for radioactive substances and irradiating apparatus (including dental X-ray units) in accordance with the requirements specified in S.I. No. 151 of 1993.

(ii) From the regulations set out in S.I. No. 43 of 1991, it can be seen that all medical exposures must be clinically justified and the need to keep such exposures as low as is reasonably achievable is emphasised. Strict limits on doses to workers and members of the public are laid down. (See Tables 1 and 2)

(iii) Medical/dental procedures involving ionising radiation must be carried out under the responsibility of qualified doctors/dental practitioners who have acquired competence in radiological protection and have been trained in diagnostic radiology techniques.

(iv) Equipment which no longer meets the criteria laid down by the RPII must be taken out of service and permanently disabled.

(v) All radiographic equipment which is in use shall be kept under strict surveillance with regard to radiological protection and quality control.
TABLE 1

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TABLE 2

ANNUAL DOSE LIMITS FOR NON-OCCUPATIONAL EXPOSED PERSONS

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<th>Dose Constraint*</th>
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<tbody>
<tr>
<td>Effective dose</td>
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</tr>
<tr>
<td>Lens of the eye</td>
<td>15 mSv</td>
<td>0.05 mSv</td>
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<tr>
<td>Skin</td>
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APPENDIX 2

Criteria for the Acceptability of X-Ray Equipment in Dentistry

1 INTRA-ORAL UNITS

<table>
<thead>
<tr>
<th>Test</th>
<th>Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. kV accuracy:</td>
<td>a) kilovoltage shall be ≥ 50</td>
</tr>
<tr>
<td></td>
<td>b) accuracy: ±10% for single phase unit, ±5% for high frequency units</td>
</tr>
<tr>
<td></td>
<td>Greater accuracy would be expected in the case of new units.</td>
</tr>
<tr>
<td>2. Filtration</td>
<td>Total permanent filtration shall be ≥ 1.5 mmAl for kVp ≤ 70 and ≥ 2.5 mmAl for kVp &gt; 70. For intra-oral units this may be checked by verifying that the first half value layer (HVL) is greater than or equal to the values shown in the table below.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measured X-ray tube voltage (kVp)</th>
<th>HVL (mmAl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 50 and ≤ 56</td>
<td>1.4</td>
</tr>
<tr>
<td>&gt; 56 and ≤ 62</td>
<td>1.6</td>
</tr>
<tr>
<td>&gt; 62 and ≤ 68</td>
<td>1.9</td>
</tr>
<tr>
<td>&gt; 68</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The value of the total permanent filtration should be marked on the tube housing.

3. Focal spot size: Focal spot size should be measured throughout the working life of the tube to determine the extent of any deterioration. The focal spot size should be < 1.5 times the nominal stated value, which should be marked on the tube housing.
4. **Size of X-ray field:** The maximum dimension of the radiation field shall be ≤ 6 cm at the patient end of the cone. The use of adjustable rectangular collimation that reduces the field size to that of the film is preferred.

5. **Timer accuracy:** The actual exposure time shall be within ± 25% and should be within ± 10% of that selected or indicated. Where an anatomical timer is fitted, the preset exposure times for each view shall be documented by the manufacturer.

6. **Radiation output:**
   a) Where a selection of kV settings are available, the output in µGy/mAs should be proportional to the \((kVp)^2\).
   b) For repeat exposures, the output shall be constant to within ± 10% for single phase units and ± 5% for high frequency units.

7. **Radiation leakage from tube housing:** Leakage radiation from the housing should not exceed 0.25 mGy (air-kerma) in one hour at 1 metre from the focus for any rating specified by the manufacturer. This measurement shall be averaged over an area of 100 cm².

8. **Skin-focus distance:** Minimum of 20 cm for kVp ≥ 60. Minimum of 18 cm for kVp < 60. Open ended cones should be used.

9. **Exposure mechanism:** X-ray exposure shall be initiated only by applying pressure to the exposure switch. Maintaining this pressure on the exposure switch must not result in a second exposure of X-rays.

    Release of pressure on the exposure switch shall terminate the production of X-rays immediately.

10. **Cable length:** The cable length shall be sufficient to allow the operator stand at least 2 metres from the X-ray tube and patient.

11. **Warning signals:** Mains 'on' and 'exposure' warning lights shall be fitted to the control panel. In addition, an audible alarm shall be fitted to the unit.
II PANORAMIC UNITS

In addition to the tests for intra-oral units it shall be checked that:

1) The focus to skin distance is at least 15 cm.

2) The size of the useful beam at the image receptor does not exceed either dimension of the scanning slit by more than 2% of the focus to image receptor distance.

III CEPHALOMETRY

In addition to the tests for intra-oral units it shall be checked that:

1) The focus to skin distance shall be at least 30 cm and should be approximately 100 cm.

2) If a collimator and light beam diaphragm are fitted then the sum of the misalignment of any two opposite edges of the visually defined field with the respective edges of the X-ray field shall not exceed 3% of the distance from the source to the centre of the visually defined field, and the sum of the deviations in two perpendicular directions shall not exceed 4%.

Where no light beam diaphragm is fitted, the X-ray field size on the film cassette at the maximum focus to cassette distance should not exceed the field size stated on the collimator. Where a distance is quoted for the field size given on the collimator, the field size shall be measured at that distance.

3) The variation in radiation output with current variation at a fixed kVp shall be linear within 15% for a single phase unit and within 10% for a three phase unit.

4) Leakage radiation from the housing shall not exceed 1 mGy (air kerma) in one hour at 1 metre from the focus at every rating specified by the manufacturer. The measurement shall be averaged over an area of 100 cm².