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TITLE 20 ENVIRONMENTAL PROTECTION
CHAPTER 3 RADIATION PROTECTION
PART 6 X-RAYS IN THE HEALING ARTS

20.3.6.1 ISSUING AGENCY: Environmental Improvement Board.
[Recompiled 11/27/01]

20.3.6.2 SCOPE: This Subpart [Part] establishes requirements, for which a registrant is responsible, for use of x-ray equipment by or under the supervision of an individual authorized by and licensed in accordance with state statutes to engage in the healing arts or veterinary medicine. The provisions of this Subpart [Part] are in addition to, and not in substitution for, other applicable provisions of these regulations.
[5-3-95; 20.3.6.2 NMAC - Rn, NMAC 3.1.6.600, Recompiled xx/xx/xx]

20.3.6.3 STATUTORY AUTHORITY: [RESERVED]

20.3.6.4 DURATION: [RESERVED]

20.3.6.5 EFFECTIVE DATE: [RESERVED]

20.3.6.6 OBJECTIVE: [RESERVED]

20.3.6.7 DEFINITIONS: As used in this Subpart [Part]:

- A. "Accessible surface" means the external surface of the enclosure or housing provided by the manufacturer.
- B. "Added filter" means the filter added to the inherent filtration.
- C. "Aluminum equivalent" means the thickness of aluminum (type 1100 alloy) affording the same attenuation, under specified conditions as the material in question. (The nominal chemical composition of type 1100 aluminum alloy is 99.00 percent minimum aluminum, 0.12 percent copper.)
- D. "Attenuation block" means a block or stack 3.8 cm thick of type 1100 aluminum alloy or other material having equivalent attenuation.
- E. "Automatic exposure control" means a device which automatically controls one or more technique factors in order to obtain at a preselected location(s) a required quantity of radiation (see also "Phototimer").
- F. "Barrier" (see "Protective barrier").
- G. "Beam axis" means a line from the source through the center of the x-ray field.
- H. "Beam-limiting device" means a device which provides a means to restrict the dimensions of the x-ray field.
- I. "Changeable filter" means any filter, exclusive of inherent filtration, which can be removed from the useful beam through any electronic, mechanical or physical process.
- J. "Coefficient of variation (SA)" means the ratio of the standard deviation to the mean value of a population of observations. It is estimated using the following equation:
where:
 x = mean value of observations in sample
 x_i = i th observation in sample
 N = number of observations in sample
- K. "Collimator" means a device or mechanism by which the x-ray beam is restricted in size.
- L. "Contact therapy system" means that the x-ray tube port is put in contact with, or within 5 centimeters of, the surface being treated.
- M. "Control panel" means that part of the x-ray control upon which are mounted the switches, knobs, pushbuttons, and other hardware necessary for manually setting the technique factors.
- N. "Cooling curve" means the graphical relationship between heat units stored and cooling time.
- O. "Dead man switch" means a switch so constructed that a circuit closing contact can be maintained only by continuous pressure on the switch by the operator.

P. "Density (D)" (as used in conjunction with image receptors) means the logarithm to the base 10 of the ratio of the incident to the transmitted luminous flux, where I is luminous flux.
 $D = \text{LOG SUB } 10 \left[\frac{I_{\text{Incident}}}{I_{\text{Transmitted}}} \right]$

Q. "Diagnostic source assembly" means the tube housing assembly with a beam-limiting device attached.

R. "Diagnostic x-ray system" means an x-ray system designed for irradiation of any part of the human body for the purpose of diagnosis or visualization.

S. "Direct scattered radiation" means that scattered radiation which has been deviated in direction only by materials irradiated by the useful beam (see also "Scattered radiation").

T. "Entrance exposure rate" means the roentgens per unit time at the point where the center of the useful beam enters the patient.

U. "Equipment" (see "X-ray equipment").

V. "Exposure" means the quotient of dQ by dm where dQ is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass dm are completely stopped in air. (The special unit of exposure is the roentgen, $1R = 2.58 \times 10^{-4} \text{ C/Kg}$)

W. "Field emission equipment" means equipment which uses an x-ray tube in which electron emission from the cathode is due solely to the action of an electric field.

X. "Filter" means material placed in the useful beam to absorb preferentially the less penetrating components.

Y. "Fluoroscopic imaging assembly" means a component which comprises a reception system in which x-ray photons produce a fluoroscopic image. It includes equipment housings, electrical interlocks if any, the primary protective barrier, and structural material providing linkage between the image receptor and the diagnostic source assembly.

Z. "General purpose radiographic x-ray system" means any radiographic x-ray system which, by design, is not limited to radiographic examination of specific anatomical regions.

AA. "Gonad shield" means a protective barrier for the testes or ovaries.

AB. "Half-value layer (HVL)" means the thickness of specified material which attenuates the beam of radiation to an extent such that the exposure rate is reduced to one-half of its original value. In this definition the contribution of all scattered radiation, other than any which might be present initially in the beam concerned, is deemed to be excluded.

AC. "Image intensifier" means a device which produces an image of greater contrast than would be produced without the device present.

AD. "Image receptor" means any device, such as a fluorescent screen or radiographic film, which transforms incident x-ray photons either into a visible image or into another form which can be made into a visible image by further transformations.

AE. "Inherent filtration" means filtration permanently in the useful beam; it includes the window of the x-ray tube and any permanent tube or source enclosure.

AF. "Interlock" means a device for precluding access to a radiation area by automatically terminating exposure upon entry by personnel.

AG. "Kilovolts peak (kVp)" (see "Peak tube potential").

AH. "kWs" means kilowatt second which is equal to the product of peak kilovolts, amperes, and seconds or 103 kVmA sec.

AI. "Lead equivalent" means the thickness of material in question affording the same attenuation, under specified conditions, as the lead in question.

AJ. "Leakage radiation" means radiation emanating from the diagnostic or therapeutic source assembly except for:

- (1) the useful beam; and
- (2) radiation produced when the exposure switch or timer is not activated.

AK. "Leakage technique factors" means the technique factors associated with the tube housing assembly which are used in measuring leakage radiation. They are defined as follows:

(1) For capacitor energy storage equipment, the maximum rated number of exposures in an hour for operation at the maximum rated peak tube potential with the quantity of charge per exposure being 10 millicoulombs (mAs) or the minimum obtainable from the unit, whichever is larger.

(2) For field emission equipment rated for pulsed operation, the maximum rated number of x-ray pulses in an hour for operation at the maximum rated peak tube potential.

(3) For all other equipment, the maximum rated continuous tube current for the maximum rated peak tube potential.

AL. "Light field" means that area of the intersection of the light beam from the beam-limiting device and one of the set of planes parallel to and including the plane of the image receptor, whose perimeter is the locus of points at which the illumination is one-fourth of the maximum in the intersection.

AM. "Line pair" means an object in which parallel wires or strips are placed so that the space between each wire or strip is equal to the width of the wire or strip. A line pair is one space and a strip or wire.

AN. "Linear Accelerator" means a device for accelerating particles employing alternate electrodes and gaps arranged in a straight line, so proportioned that when their potentials are varied in the proper amplitude and frequency, particles passing through them receive successive increments of energy.

AO. "Line-voltage regulation" means the difference between the no-load and the load potentials expressed as a percent of the load line potential, that is: $\text{Percent line-voltage regulation} = 100 (V_n - V_1) / V_1$ where:

(1) V_n = No-load line potential and

(2) V_1 = Load line potential

AP. "Maximum line current" means the root mean square current in the supply line of an x-ray machine operating at its maximum rating.

AQ. "Mobile equipment" (see "X-ray equipment").

AR. "Peak tube potential" means the maximum value of the potential difference across the x-ray tube during an exposure.

AS. "Personal monitoring" means the estimation of dose to a person.

AT. "Phototimer" means a method for controlling radiation exposures to image receptors by the amount of radiation which reaches a radiation monitoring device(s). The radiation monitoring device(s) is part of an electronic circuit which controls the duration of time the tube is activated (see also "Automatic exposure control").

AU. "Portable equipment" (see "X-ray equipment").

AV. "Position indicating device (PID)" means a device on dental x-ray equipment used to indicate the beam position and to establish a definite source-surface (skin) distance. It may or may not incorporate or serve as a beam-limiting device.

AW. "Primary protective barrier" (see "Protective barrier").

AX. "Protective apron" means an apron made of radiation absorbing materials, used to reduce radiation exposure.

AY. "Protective barrier" means a barrier of radiation absorbing material(s) used to reduce radiation exposure. The types of protective barriers are as follows:

(1) "Primary protective barrier" means the material, excluding filters, placed in the useful beam, for protection purposes, to reduce the radiation exposure; and

(2) "Secondary protective barrier" means a barrier sufficient to attenuate the stray radiation to the required degree.

AZ. "Protective glove" means a glove made of radiation absorbing materials used to reduce radiation exposure.

BA. "Qualified expert" (see 106.CC [Subsection CC. Of Section 7 of 20.3.1.7 NMAC]).

BB. "Radiograph" means an image receptor on which the image is created directly or indirectly by an x-ray pattern and results in a permanent record.

BC. "Radiographic imaging system" means any system whereby a permanent or semi-permanent image is recorded on an image receptor by the action of ionizing radiation.

BD. "Recording" means producing a permanent form of an image resulting from x-ray photons (e.g., film, video tape).

BE. "Registrant", as used in this Subpart [Part], means any person who owns or possesses and administratively controls an x-ray system which is used to deliberately expose humans or animals to the useful beam of the system and is required by the provisions in Subpart 1 and 2 [Part 1 and 2] of these regulations to register with this Department.

BF. "Repair person (Service person)" means an individual who maintains an x-ray system; not limited to a manufacturer, assembler or user.

BG. "Response time" means the time required for an instrument system to reach 90 percent of its final reading when the radiation-sensitive volume of the instrument system is exposed to a step change in radiation flux from zero sufficient to provide a steady state midscale reading.

BH. "Scattered radiation" means radiation that, during passage through matter, has been deviated in direction (see also "Direct scattered radiation").

- BI. "Secondary protective barrier (see "Protective barrier").
- BJ. "SID" (see "Source-image receptor distance").
- BK. "Source" means the focal spot of the x-ray tube.
- BL. "Source-image receptor distance (SID)" means the distance from the source to the center of the input surface of the image receptor.
- BM. "Spot film" means a radiograph which is made during a fluoroscopic examination to permanently record conditions which exist during that fluoroscopic procedure.
- BN. "Stationary equipment " (see "X-ray equipment").
- BO. "Stray radiation" means the sum of leakage and scattered radiation.
- BP. "Technique factors" means the conditions of operation. They are specified as follows:
- (1) For capacitor energy storage equipment, peak tube potential in kVp and quantity of charge in mAs;
 - (2) For field emission equipment rated for pulsed operation, peak tube potential in kVp and number of x-ray pulses; and
 - (3) For all other equipment, peak tube potential in kVp and either tube current in mA and exposure time in seconds, or the product of tube current and exposure time in mAs.
- BQ. "Therapeutic-type protective tube housing" means the tube housing with tube installed and it includes high voltage or filament transformers and other appropriate elements when they are contained within that housing.
- BR. "Tube" means an x-ray tube, unless otherwise specified.
- BS. "Tube housing assembly" means the tube housing with tube installed. It includes high-voltage or filament transformers and other appropriate elements when they are contained within the tube housing.
- BT. "Tube rating chart" means the set of curves which specify the rated limits of operation of the tube in terms of the technique factors.
- BU. "Useful beam" means the radiation which passes through the tube housing port and the aperture of the beam-limiting device when the exposure switch or timer is activated.
- BV. "Variable-aperture beam-limiting device" means a beam-limiting device which has capacity for stepless adjustment of the x-ray field size at a given SID.
- BW. "Visible area" means that portion of the input surface of the image receptor over which incident x-ray photons produce a visible image.
- BX. "X-ray control" means a device which controls input power to the x-ray high-voltage generator of the x-ray tube. It includes equipment which controls the technique factors of an x-ray exposure.
- BY. "X-ray equipment" means an x-ray system, subsystem or component thereof. Types of x-ray equipment are as follows:
- (1) Mobile means x-ray equipment mounted on a permanent base with wheels or casters for moving while completely assembled;
 - (2) Portable means x-ray equipment designed to be hand-carried;
 - (3) Stationary means x-ray equipment which is installed in a fixed location; and
 - (4) Transportable means x-ray equipment installed in a vehicle or trailer.
- BZ. "X-ray field" means that area of the intersection of the useful beam and any one of the set of planes parallel to and including the plane of the image receptor, whose perimeter is the locus of points at which the exposure rate is one-fourth of the maximum in the intersection.
- CA. "X-ray high-voltage generator" means a device which transforms electrical energy from the potential supplied by the x-ray control to the tube operating potential. The device may also include means for transforming alternating current to direct current, filament transformers for the x-ray tube(s), high-voltage switches, electrical protective devices, and other appropriate elements.
- CB. "X-ray system" means an assemblage of components for the controlled production of x-rays. It includes minimally an x-ray high-voltage generator, an x-ray control, a tube housing assembly, a beam-limiting device, and the necessary supporting structures.
- CC. "X-ray subsystem" means any combination of two or more components of an x-ray system for which there are requirements specified in this Subpart [Part].
- CD. "X-ray tube" means any electron tube which is designed for the conversion of electrical energy into x-ray energy.
- [5-3-95; 20.3.6.7 NMAC – Rn, 20 NMAC 3.1.6.601, Recompiled xx/xx/xx]

20.3.6.602 GENERAL REQUIREMENTS:

A. Administrative Controls:

(1) Registrant: The registrant shall be responsible for directing the operation of the x-ray machines which he has registered with the Department. He or his agent shall assure that the following provisions are met in the operation of the x-ray machine(s).

(a) An x-ray machine which does not meet the provision of these regulations shall not be operated for diagnostic or therapeutic purposes, if so directed by the Department.

(b) Individuals who will be operating the x-ray equipment shall be adequately instructed in the safe operating procedures and be competent in the safe use of the equipment.

(c) In the vicinity of each x-ray system's control panel a chart shall be provided which specifies for all examinations which are performed by that system a listing of information, including but not limited to the following, for each projection within that examination:

- (i) patient's anatomical size versus technique factors to be utilized;
- (ii) type of and size of the film or film-screen combination to be used;
- (iii) type of grid to be used if any, and focal distance;
- (iv) source to image receptor distance to be used; and
- (v) type and location of placement of gonad shielding to be used.

(d) Written safety procedures and rules shall be provided to each individual operating x-ray equipment under his control, including any restrictions of the operating technique required for the safe operation of the particular x-ray system. The operator shall be able to demonstrate familiarity with these rules.

(e) Except for patients who cannot be moved out of the room, only the staff and ancillary personnel required for the medical procedure or training shall be in the room during the radiographic exposure. Other than the patient being examined:

(i) all individuals shall be positioned such that no part of the body including the extremities not protected by 0.5 mm lead equivalent, will be struck by the useful beam;

(ii) staff and ancillary personnel shall be protected from the direct scatter radiation by protective aprons or whole body protective barriers of not less than 0.25 mm lead equivalent;

(iii) patients who cannot be removed from the room shall be protected from the direct and scatter radiation by whole body protective barriers of 0.25 mm lead equivalent or shall be so positioned that the nearest portion of the body is at least 2 meters from both the tube head and the nearest edge of the image receptor;

(iv) when a portion of the body of any staff or ancillary personnel is potentially subjected to stray radiation which could result in that individual receiving one quarter of the maximum permissible dose as defined in Subpart 4 [Part 4] additional protective devices may be required by the Department;

(f) Gonad shielding of not less than 0.25 mm lead equivalent shall be used for patients who have not passed the reproductive age during radiographic procedures in which the gonads are in the direct (useful) beam, except for cases in which this would interfere with the diagnostic procedures;

(g) Patients shall not be exposed to the useful beam except for healing arts purposes, each exposure of which has been authorized by a licensed practitioner of the healing arts. This provision specifically prohibits deliberate exposure for the following purposes:

(i) exposure of an individual for training, demonstration or other purpose unless there are also healing arts requirements and proper prescription has been provided; and

(ii) exposure of an individual for the purpose of healing arts screening without prior written approval of the Department. (Screening means an exposure of a person without a prior examination by a licensed practitioner).

(h) When a patient or film must be provided with auxiliary support during a radiation exposure:

(i) mechanical holding devices shall be used when the technique permits. The safety rules, required by 602 [Section 602 of 20.3.6.602 NMAC], shall list individual projections where holding devices cannot be utilized;

(ii) written safety procedures, as required by 602.A.1.d [Subparagraph (d), Paragraph (1), Subsection A., Section 602 of 20.3.6.602 NMAC], shall indicate the requirements for selecting a holder and the procedure the holder shall follow;

(iii) the human holder shall be protected as required by 602.A.1.e [Subparagraph (e), Paragraph (1), Subsection A., Section 602 of 20.3.6.602 NMAC];

(iv) no person shall be used routinely to hold film or patients;

(v) such holding shall be permitted only in very unusual and rare situations; and

(vi) all x-ray room doors shall be closed before an exposure is made;

(i) Procedures and auxiliary equipment designed to minimize patient and personnel exposure commensurate with the needed diagnostic information shall be utilized. This is interpreted to include but is not limited to:

(i) the speed of film or screen and film combinations shall be the fastest speed consistent with the diagnostic objective of the examinations;

(ii) the radiation exposure to the patient shall be the minimum exposure required to produce images of good diagnostic quality; and

(iii) portable or mobile equipment shall be used only for examinations where it is impractical to transfer the patient(s) to a stationary installation;

(j) Personnel monitoring. All persons who are associated with the operation of an x-ray system are subject to the occupational exposure limits and the requirements for the determination of the doses which are stated in 405 and 412 [Section 405 and 412 of 20.3.4.405 and 412 NMAC]. In addition, the following requirements are made:

(i) when protective clothing or devices are worn on portions of the body and a monitoring device(s) is required, at least one such device shall be utilized as follows: 1) when an apron is worn, the monitoring device shall be worn at collar level outside of the apron; and 2) the dose to the whole body based on the maximum dose attributed to any one critical organ (which are the gonads, the blood forming organs, head and trunk, or lens of the eye) shall be recorded in the reports required by 452 [Section 452 of 20.3.4.452 NMAC]. If more than one device is used, each dose shall be identified with the area of the body where the device was worn;

(ii) exposure of a personnel monitoring device to deceptively indicate a dose delivered to an individual is prohibited.

(2) Information and Maintenance Record and Associated Information: The registrant shall maintain at least the following information for each x-ray machine:

(a) Maximum rating of technique factors;

(b) Model numbers of all certifiable components;

(c) Aluminum equivalent filtration of the useful beam; including any routine variation;

(d) Tube rating charts and cooling curves;

(e) Record of surveys, calibrations, maintenance, modifications (from the original schematics and drawings) performed on the x-ray machine after the effective date of these regulations, along with the names of persons who performed the service;

(f) A scale drawing of the room in which a stationary x-ray system is located. The drawing shall denote the type of materials and their thickness (or lead equivalence) provided by each barrier of the room (walls, ceilings, floors, doors, windows). The drawing shall also denote the type of occupancy of adjacent areas to include above and below the x-ray room of concern (e.g., hallways, office, parking lots, and toilets). Estimates of the frequency of such occupancy shall also be noted on the drawing; and

(g) A copy of all correspondence with this Department regarding that x-ray machine.

(3) X-ray Log. Each facility shall maintain an x-ray log containing the examinations and the dates those examinations were performed. The log shall indicate when techniques for procedures vary from those specified in the technique chart required in 602.A.1.c [Subparagraph (c), Paragraph (1), Subsection A., Section 602 of 20.3.6.602 NMAC].

B. Plan Review:

(1) Prior to construction, the floor plans and equipment arrangement of all installations (new or modifications of existing installations) utilizing x-rays for diagnostic or therapeutic purposes shall be submitted to the Department for review and approval. The required information is denoted in Subpart 6, 610 and 611 [Part 6, Sections 610 and 611 of 20.3.6.610 and 611].

(2) The Department may require the applicant to utilize the services of a qualified expert to determine the shielding requirement prior to the plan review and approval.

(3) The approval of such plans shall not preclude the requirement of additional modifications should a subsequent analysis of operating conditions indicate the possibility of an individual receiving a dose in excess of the limits prescribed in 405 to 412 [Sections 405 to 412 of 20.3.4.405 to 412 NMAC].

(4) For all medical facilities in hospitals or clinics, interlocks shall be required on all doors leading into diagnostic x-ray rooms when the doors cannot be seen by the operator at the control station.

C. Chemicals, film processing and darkroom will be complied with in accordance with Subpart 6, 612 [Part 6, Section 612 of 20.3.6.612 NMAC].

[5-3-95: 20.3.6.602 NMAC – Rn, 20 NMAC 3.1.6.602, Recompiled xx/xx/xx]

20.3.6.603 GENERAL REQUIREMENTS FOR ALL DIAGNOSTIC X-RAY SYSTEMS: In addition to other requirements of this Subpart, all diagnostic x-ray systems shall meet the following requirements:

- A. Warning Label: The control panel containing the main power switch shall bear the warning statement, legible and accessible to view: "WARNING: This X-ray Unit May Be Dangerous To Patient and Operator Unless Safe Exposure Factors and Operating Instructions Are Observed";
- B. Battery Charge Indicator: On battery-powered generators, visual means shall be provided on the control panel to indicate whether the battery is in a state of charge adequate for proper operation;
- C. Leakage Radiation from the Diagnostic Source Assembly: The leakage radiation from the diagnostic source assembly measured at a distance of 1 m in any direction from the source shall not exceed 100 mR (1 mSv) in 1 hour when the x-ray tube is operated at its leakage technique factor. Compliance shall be determined by measurements averaged over an area of 100 sq cm (39.37 inches) with no linear dimension greater than 20 cm (7.87 inches); and
- D. Radiation from Components other than the Diagnostic Source Assembly: The radiation emitted by a component other than the diagnostic source assembly shall not exceed 2 mR (2 mSv) in 1 hour at 5 cm from any accessible surface of the component when it is operated in an assembled x-ray system under any conditions for which it was designed. Compliance shall be determined by measurements averaged over an area of 100 sq cm (39.37 inches) with no linear dimension greater than 20 cm (7.87 inches).
- E. Beam Quality:
 - (1) Half-value layer:
 - (a) The half-value layer (HVL) of the useful beam for a given x-ray tube potential shall not be less than the values shown in Table 603.1 [Table 1, Section 603 of 20.3.6.603 NMAC]. If it is necessary to determine such half-value layer at an x-ray tube potential which is not listed in Table 603.1 [Table I, Section 603 of 20.3.6.603 NMAC], linear interpolation or extrapolation may be made.

TABLE I

Design operating range (Kilovolts peak)	Measured potential (Kilovolts peak)	Half-value layer (Millimeters of)
Below 50	aluminum	
	30	0.3
	40	0.4
50 to 70	49	0.5
	50	1.2
	60	1.3
	70	1.5
Above 70	71	2.1
	80	2.3
	90	2.5
	100	2.7
	110	3.0
	120	3.2
	130	3.5
	140	3.8
	150	4.1

(b) The above HVL criteria will be considered to have been met if it can be demonstrated that the aluminum equivalent of the total filtration in the primary beam is not less than that shown in Table 603.2 [Table II of Section 603, 20.3.6.603 NMAC].

TABLE II

FILTRATION REQUIRED vs. OPERATING VOLTAGE

Total Filtration Operating Voltage	(inherent plus added) (millimeters aluminum (kVp)equivalent)
Below 50	0.5 mm
50 - 70	1.5 mm
Above 70	2.5 mm

(c) Beryllium window tubes shall have a minimum of 0.5 mm aluminum equivalent filtration permanently mounted in the useful beam.

(d) For capacitor energy storage equipment, compliance shall be determined with the maximum quantity of charge per exposure.

(e) The required minimal aluminum equivalent filtration shall include the filtration contributed by all materials which are always present between the focal spot of the tube and the patient (e.g., a tabletop when the tube is mounted "under the table" and inherent filtration of the tube).

(2) Filtration control: For x-ray systems manufactured after August 1, 1974, which have variable kVp and variable filtration for the useful beam, a device shall link the kVp selector with the filter(s) and will prevent an exposure unless the minimum required amount of filtration (see Table 603.1 or Table 603.2 above [Table I or II, Section 603 of 20.3.6.603 NMAC]) is in the useful beam for the given kVp which has been selected.

F. Multiple Tubes: Where two or more radiographic tubes are controlled by one exposure switch, the tube or tubes which have been selected shall be clearly indicated prior to initiation of the exposure. This indication shall be both on the x-ray control and at or near the tube housing assembly which has been selected.

G. Mechanical Support of Tube Head: The tube housing assembly supports shall be adjusted such that the tube housing assembly will remain stable during an exposure unless the tube housing movement is a designed function of the x-ray system.

H. Technique Indicators:

(1) The technique factors to be used during an exposure shall be indicated before the exposure begins, except when automatic exposure controls are used, in which case the technique factors which are set prior to the exposure shall be indicated.

(2) On equipment having fixed technique factors, the requirement, 603.H.1 [Paragraph (1), Subsection H., Section 603 of 20.3.6.603 NMAC], may be met by permanent markings. Indication of technique factors shall be visible from the operator's position except in the case of spot films by the fluoroscopist.
[5-3-95; 20.3.6.603 NMAC – Rn, 20 NMAC 3.1.6.603, Recompiled xx/xx/xx]

20.3.6.604 FLUOROSCOPIC X-RAY SYSTEMS: All fluoroscopic x-ray systems shall meet the following requirements.

A. Limitation of Useful Beam:

(1) The fluoroscopic tube shall not produce x-rays unless the primary protective barrier is in position to intercept the entire useful beam at all times.

(2) The entire cross-section of the useful beam shall be intercepted by the primary protective barrier of the fluoroscopic image assembly at any SID.

(3) Limitation to the Imaging Surface.

(a) Non-Image-Intensified Fluoroscopy and Spot Filming: The x-ray field produced by non-image-intensified fluoroscopic equipment shall not extend beyond the entire visible area of the image receptor. This requirement applies to field size during both fluoroscopic procedures and spot-filming procedures.

(b) Image-Intensified Fluoroscopy and Spot Filming.

(i) During fluoroscopic or spot-filming procedures, neither the length nor the width of the x-ray field in the plane of the image receptor shall exceed the visible area of the image receptor by more than 3 percent of the SID. The sum of the excess length and the excess width shall be no greater than 4 percent of the SID.

(ii) Compliance shall be determined with the beam axis perpendicular to the image receptor. For rectangular x-ray fields used with circular image reception, the error in alignment shall be determined along the length and width dimensions of the x-ray field which pass through the center of the visible area of the image receptor.

B. Activation of the Fluoroscopic Tube: X-ray production in the fluoroscopic mode shall be controlled by a device which requires continuous pressure by the fluoroscopist for the entire time of any exposure. When recording serial fluoroscopic images, the fluoroscopist shall be able to terminate the x-ray exposure(s) at any time, but means may be provided to permit completion of any single exposure of the series in process.

C. Entrance Exposure Rate Allowable Limits:

(1) The exposure rate measured at the point where the center of the useful beam enters the patient shall not exceed 10 R per minute, (2.58 mC/kg) except during recording of fluoroscopic images or when provided with optional high-level control.

(2) When provided with optional high-level control, the equipment shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 5 Rem (1.29 mC/kg) per

minute at the point where the center of the useful beam enters the patient unless the high-level control is activated. A continuous signal audible to the fluoroscopist shall indicate that the high-level control is being employed.

(3) Measuring Compliance of Entrance Exposure Rate Limits: Compliance with 604.C [Subsection C., Section 604 of 20.3.6.604 NMAC] shall be determined by:

(a) removing movable grids and compression devices from the useful beam during the measurements;

(b) if the source is below the table, express exposure rate, 1 cm above the tabletop or cradle;

(c) express exposure rate, if the source is above the table, 30 cm above the tabletop with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement; and

(d) in a C-arm type of fluoroscope, the exposure rate shall be measured, 30 cm (11.81 inches) from the input surface of the fluoroscopic imaging assembly.

(4) Periodic measurement of entrance exposure rate limits:

(a) periodic measurements of the exposure rate shall be made by a qualified expert. An adequate period for such measurements shall be annually or after any maintenance of the system which might affect the exposure rate.

(b) results of these measurements shall be posted where any fluoroscopist may have ready access to such results while using that fluoroscope and in the record required in 602.A.2.e [Subparagraph (e), Paragraph (2), Subsection A., Section 602 of 20.3.6.602 NMAC]. Results of the measurements shall include the maximum possible Rem/per minute, (1.29 mC/kg) as well as the physical factors used to determine all data; the name of the person performing the measurements; and the date the measurements were performed.

(c) Use of monitoring devices (e.g., commercially available film badges, thermoluminescent dosimeters, or low-energy dosimeters) may be used to perform the test, provided the measurements are made as noted in 604.C.4.d [Subparagraph (d), Paragraph (4), Subsection C. Section 604 of 20.3.6.604 NMAC].

(d) Conditions of measurement:

(i) the measurement shall be made under the conditions that satisfy the requirements of 604.C.3 [Paragraph (3), Subsection C., Section 604 of 20.3.6.604 NMAC];

(ii) the kVp shall be the peak Kv that the x-ray system is capable of producing;

(iii) the high-level control, if present, shall not be activated;

(iv) the x-ray systems that do not incorporate automatic exposure control (automatic brightness control, etc.) shall have sufficient material (e.g., lead or lead equivalence) placed in the useful beam to produce the maximum milliamperage of the x-ray system; and

(v) x-ray systems that incorporate automatic exposure control shall utilize the maximum milliamperage of the x-ray system. Materials (e.g. an attenuation block) may be placed in the useful beam to protect the imaging system.

D. Barrier Transmitted Radiation Rate Limits:

(1) The exposure rate due to transmission through the primary protective barrier with the attenuation block in the useful beam combined with radiation from the image intensifier, if provided, shall not exceed 2 mR (0.516 mC/kg) per hour at 10 cm (3.93 inches) from any surface of the fluoroscopic imaging assembly beyond the plane of the image receptor for each roentgen per minute of entrance exposure rate.

(2) Measuring compliance of barrier transmission:

(a) The exposure rate due to transmission through the primary protective barrier combined with radiation from the image intensifier shall be determined by measurements averaged over an area of 100 sq cm with no linear dimension greater than 20 cm (7.87 inches).

(b) If the source is below the tabletop, the measurement shall be made with the input surface of the fluoroscopic imaging assembly, positioned 30 cm (11.81 inches) above the tabletop.

(c) If the source is above the tabletop and the SID is variable, the measurement shall be made with the end of the beam-limiting device or spacer as close to the tabletop as it can be placed, provided that it shall not be closer than 30 cm (11.81 inches).

(d) Movable grids and compression devices shall be removed from the useful beam during the measurement.

(e) The attenuation block shall be positioned in the useful beam 10 cm (3.93 inches) from the point of measurement of entrance exposure rate and between this point and the input surface of the fluoroscopic imaging assembly.

E. Indication of Potential and Current: During fluoroscopy and cinefluorography, x-ray tube potential and current shall be continuously indicated.

F. Source-Skin Distance: The source to skin distance shall not be less than:

- (1) 38 cm (14.96 inches) on stationary fluoroscopes installed after March 10, 1989;
- (2) 35.5 cm (13.98 inches) on stationary fluoroscopes which are in operation prior to March 10, 1989;
- (3) 30 cm (11.81 inches) on all mobile fluoroscopes; and
- (4) 20 cm (7.87 inches) for image intensified fluoroscopes used for specific surgical application. The users operating manual must provide precautionary measures to be adhered to during the use of this device.

G. Fluoroscopic Timer:

- (1) Means shall be provided to preset the cumulative on-time of the fluoroscopic tube. The maximum cumulative time of the timing device shall not exceed 5 minutes without resetting.
- (2) A signal audible to the fluoroscopist shall indicate the completion of any preset cumulative on-time. Such signal shall continue to sound while x-rays are produced until the timing device is reset.

H. Mobile Fluoroscopes: In addition to the other requirements of 604 [Section 604 of 20.3.6.604 NMAC], mobile fluoroscopes shall provide intensified imaging.

I. Control of Scattered Radiation:

(1) Fluoroscopic table designs when combined with procedures utilized shall be such that no unprotected part of any staff or ancillary person's body shall be exposed to unattenuated scattered radiation which originates from under the table. The attenuation required shall be not less than 0.25 mm lead equivalent.

(2) Equipment configuration when combined with procedures shall be such that no portion of any staff or ancillary person's body, except the extremities, shall be exposed to the unattenuated scattered radiation emanating from above the tabletop unless that individual:

- (a) is at least 120 cm (47.24 inches) from the center of the useful beam; or
- (b) the radiation has passed through not less than 0.25 mm lead equivalent material (e.g., drapes, Bucky-slot cover, sliding or folding panel, or self supporting curtains) in addition to any lead equivalency provided by the protective apron referred to in 602 A.1.e.(2)[Item (ii), Subparagraph (e), Paragraph (1), Subsection A., Section 602 of 20.3.6.602 NMAC]; and

(c) Exceptions to 604.I.2 [Paragrph (2), Subsection I., Section 604 of 20.3.6.604 NMAC] may be made in some special procedures where a sterile field will not permit the use of the normal protective barriers. Where the use of the prefitted sterilized cover for the barriers is practical, the Department shall not permit such exception.

[5-3-95; 20.3.6.604 NMAC – Rn, 20 NMAC 3.1.6.604, Recompiled xx/xx/xx]

20.3.6.605 RADIOGRAPHIC SYSTEMS OTHER THAN FLUOROSCOPIC, DENTAL, INTRAORAL, OR VETERINARIAN OR COMPUTED TOMOGRAPHY X-RAY SYSTEMS:

A. Beam Limitation: The useful beam shall be limited to the area of clinical interest.

(1) General purpose stationary and mobile x-ray systems:

(a) Variable held limitation: There shall be provided a means for stepless adjustment of the size of the x-ray field. The minimum field size at a SID of 100 cm shall be equal to or less than 5 cm (1.96 inches) by 5 cm (1.96 inches).

(b) Visual Definition: Means shall be provided for visually defining the perimeter of the x-ray field. The total misalignment of the edges of the x-ray field along either the length or width of the visually defined field shall not exceed 2 percent of the distance from the source to the center of the visually defined field when the surface upon which it appears is perpendicular to the axis of the x-ray beam.

(2) Additional Requirements for Stationary General Purpose X-ray Systems: In addition to the requirements in 605.A.1 [Paragraph (1), Subsection A., Section 605 of 20.3.6.605 NMAC] above, all stationary x-ray systems shall:

(a) provide means to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor, to align the center of the x-ray field with respect to the center of the image receptor to within 2 percent of the SID, and to indicate the SID to within 2 percent;

(b) be equipped with a beam-limiting device that numerically indicates the field size in the plane of the image receptor to which it is adjusted; and

(c) indicate field size dimensions and SID's in inches or cm, and shall be such that aperture adjustments result in x-ray field dimensions in the plane of the image receptor which correspond to those of the image receptor to within 2 percent of the SID when the beam axis is perpendicular to the plane of the image receptor.

(3) X-ray Systems Designed for One Image Receptor Size: Radiographic equipment designed for only one image receptor size at a fixed SID shall be provided with means to limit the field at the plane of the image

receptor to dimensions no greater than those of the image receptor, and to align the center of the x-ray field with the center of the image receptor to within 2 percent of the SID.

(4) Special purpose x-ray systems:

(a) Shall be provided with means to limit the x-ray field in the plane of the image receptor so that such field does not exceed each dimension of the image receptor by more than 2 percent of the SID when the axis of the x-ray beam is perpendicular to the plane of the image receptor.

(b) Shall be provided with means to align the center of the x-ray field with the center of the image receptor to within 2 percent of the SID.

(c) The above, 605.A.4.a and 605.A.4.b [Subparagraphs (a) and (b), Paragraph (4), Subsection A., Section 605 of 20.3.6.605 NMAC], may be met with a system that meets the requirements for a general purpose x-ray system as specified in 605.A.1 [Paragraph (1), Subsection A., Section 605 of 20.3.6.605 NMAC] above or, when alignment means are also provided, may be met with either:

(i) an assortment of removable, fixed-aperture, beam-limiting devices sufficient to meet the requirements for each combination of image receptor size and SID for which the unit is designed (each such device shall have clear and permanent markings to indicate the image receptor size and SID for which it is designed); or

(ii) a beam-limiting device having multiple fixed apertures sufficient to meet the requirements for each combination of image receptor size and SID for which the unit is designed. Permanent, clearly legible markings shall indicate the image receptor size and SID for which each aperture is designed and shall indicate which aperture is in position for use.

B. Radiation Exposure Control Devices:

(1) Timers: Means shall be provided to terminate the exposure at a preset time interval, preset product of current and time, a preset number of pulses, or a preset radiation exposure to the image receptor. In addition:

(a) termination of exposure shall cause automatic resetting of the timer to its initial setting or to zero; and

(b) it shall not be possible to make an exposure when the timer is set to a zero or off position if either position is provided.

(2) X-ray control (exposure switch):

(a) A control shall be incorporated into each x-ray system such that an exposure can be terminated at any time except for:

(i) exposure of one-half second or less; or

(ii) during serial radiography when means shall be provided to permit completion of any single exposure of the series in process.

(b) Each x-ray control shall:

(i) for stationary x-ray systems be permanently mounted in a protected area so that the operator is required to remain in that protected area during the entire exposure; or

(ii) mobile and portable x-ray systems which are: 1) used for greater than one week in one location (one room or suite) shall meet the requirements of 605.B.2.b.(1) [Item (i), Subparagraph (b), Paragraph (2), Subsection B., Section 605 of 20.3.6.605 NMAC] above; 2) used for more than 1 hour and less than 1 week at one location (one room, or suite) shall meet the requirement of 605.B.2.b.(2)(a) [Item (ii), Subparagraph (b), Paragraph (2), Subsection B., Section 605 of 20.3.6.605 NMAC] or be provided with 1.98 m (6.5 feet) high protective barrier which is placed at least 1.83 m (6 feet) from the tube housing assembly and at least 1.83 m (6 feet) from the patient; or 3) used to make an exposure(s) of only one patient at the use location shall meet the requirement of 605.B.2.b.(2)(a) [Item (ii), Subparagraph (b), Paragraph (2), Subsection B., Section 605 of 20.3.6.605 NMAC] or 605.B.2.b.(2)(b) [Item (ii), Subparagraph (b), Paragraph (2), Subsection B., Section 605 of 20.3.6.605 NMAC] or be provided with a method of control which will permit the operator to be at least 3.66 m (12 feet) from the tube head assembly during an exposure.

(iii) the x-ray control shall provide visual indication observable at or from the operator's protected position whenever x-rays are produced. In addition, a signal audible to the operator shall indicate that the exposure has terminated.

(3) Automatic Exposure Controls (Phototimer): When an automatic exposure control is provided:

(a) indication shall be made on the control panel when this mode of operation is selected;

(b) when the x-ray tube potential is equal to or greater than 50 kVp, the minimum exposure time for field emission equipment rated for pulsed operation shall be equal to or less than a time interval equivalent to two pulses;

(c) the minimum exposure time for all equipment other than specified in 605.B.3.b [Subparagraph (b), Paragraph (3), Subsection B., Section 605 of 20.3.6.605 NMAC] shall be equal to or less than 1/60 second or a time interval required to deliver 5 mAs, whichever is greater;

(d) Either the product of peak x-ray tube potential, current, and exposure time shall be limited to not more than 60 kW per exposure or the product of x-ray tube current and exposure time shall be limited to not more than 600 mAs per exposure except when the x-ray tube potential is less than 50 kVp in which case the product of x-ray tube current and exposure time shall be limited to not more than 2000 mAs per exposure; and

(e) A visible signal shall indicate when an exposure has been terminated at the limits described in 605.B.3.d [Subparagraph (d), Paragraph (3), Subsection B., Section 605 of 20.3.6.605 NMAC], and manual resetting shall be required before further automatically timed exposures can be made. [5-3-95]

(4) Reproducibility: With a timer setting of 0.5 seconds or less, the average exposure period (T) shall be greater than or equal to 5 times the maximum exposure period (Tmax) minus the minimum exposure period (Tmin) when 4 timer tests are performed: $T \geq 5(T_{max} - T_{min})$.

C. Source-to-Source or Receptor Distance Limitation: All radiographic systems shall be provided with a durable, securely fastened means to limit the source-to-skin distance to not less than 30 cm (11.81 inches). This can be met when the collimator or cone provides the required limits.

D. Exposure Reproducibility: The exposure produced shall be reproducible to within the following criteria: When all technique factors are held constant, the coefficient of variation shall not exceed 0.10. This shall be deemed to have been met if when four exposures at identical technique factors are made that the value of the average exposure (E) is greater than or equal to five times the maximum exposure (Emax), minus the minimum exposure (Emin). $E \geq 5(E_{max} - E_{min})$

E. Standby Radiation from Capacitor Energy Storage Equipment: Radiation emitted from the x-ray tube when the exposure switch or timer is not activated shall not exceed a rate of 2 mR (20 mSv) per hour at 5 cm (1.96 inches) from any accessible surface of the diagnostic source assembly, with the beam-limiting device fully open.

[5-3-95; 20.3.6.605 NMAC – Rn, 20 NMAC 3.1.6.605, Recompiled xx/xx/xx]

20.3.6.606 INTRAORAL DENTAL RADIOGRAPHIC SYSTEMS: In addition to the provisions of 602 and 603 [Sections 602 and 603 of 20.3.6.602 and 603 NMAC], the requirements of this section apply to x-ray equipment and associated facilities used for dental radiography. Criteria for extraoral dental radiographic systems are covered in 605 [Section 605 of 20.3.6.605 NMAC].

A. Source-to-Skin Distance: X-ray systems designed for use with an intraoral image receptor shall be provided with means to limit source-to-skin distance to not less than:

- (1) 18 cm (7.09 inches) if operable above 50 kVp; or
- (2) 10 cm (3.93 inches) if not operable above 50 kVp.

B. Field Limitation:

(1) Radiographic systems designed for use with an intraoral image receptor shall be provided with means to limit the x-ray beam such that:

(a) if the minimum source-to-skin distance (SSD) is 18 cm (7.09 inches) or more, the x-ray field, at the minimum SSD, shall be containable in a circle having a diameter of no more than 7 cm (2.76 inches); and

(b) if the minimum SSD is less than 18 cm, (7.09 inches) the x-ray field, at the minimum SSD, shall be containable in a circle having a diameter of no more than 6 cm (2.36 inches).

C. Timers: Means shall be provided to terminate the exposure at a preset time interval, preset product of current and time, a preset number of pulses, or a preset radiation exposure to the image receptor. In addition:

(1) Termination of exposure shall cause automatic resetting of the timer to its initial setting or to zero;

(2) It shall not be possible to make an exposure when the timer is to a zero or off position if either position is provided;

(3) Reproducibility: With a timer setting of 0.5 seconds or less, the average exposure period (T) shall be greater than or equal to 5 times the maximum exposure period (Tmax) minus the minimum exposure period (Tmin) when 4 timer tests are performed: $T \geq 5(T_{max} - T_{min})$.

D. X-ray Control (use of dead-man timers):

(1) A control shall be incorporated into each x-ray system such that an exposure can be terminated at any time, except for exposures of one-half second or less;

(2) Each x-ray control shall be located in such a way as to meet the following criteria:

(a) for stationary x-ray systems, it shall be required that the control switch be permanently mounted in a protected area (e.g., corridor outside the room) so that the operator is required to remain in that protected area during the entire exposure;

(b) for mobile and portable x-ray systems which are:

(i) used for greater than 1 week in one location (one room or suite) shall meet the requirements of 606.D.2.a [Subparagraph (a), Paragraph (2), Subsection D., Section 606 of 20.3.6.606 NMAC];

(ii) used for more than 1 hour and less than 1 week at one location (one room, or suite) shall meet the requirements of 606.D.2.b.(1) [Item (i), Subparagraph (b), Paragraph (2), Subsection D., Section 606 of 20.3.6.606 NMAC] or be provided with 1.98 m (6.5 feet) high protective barrier which is placed at least 1.83 m (6 feet) from the tube housing assembly and at least 1.83 m (6 feet) from the patient;

(iii) used to make an exposure(s) of only one patient at the use location shall meet the requirement of 606.D.2.b.(1) or 606.D.2.b.(2) [Items (i) or (ii), Subparagraph (b), Paragraph (2), Subsection D., Section 606 of 20.3.6.606 NMAC] or be provided with a method of control which will permit the operator to be at least 3.63 m (12 feet) from the tube head assembly during an exposure.

(3) The x-ray control shall provide visual indication observable at or from the operator's protected position whenever x-rays are produced. In addition, a signal audible to the operator shall indicate that the exposure has terminated; and

(4) From the operator's position, the patient must be capable of being viewed directly or via mirrors.

E. Exposure Reproducibility: The exposure produced shall be reproducible to within the following criteria: When all technique factors are held constant, the coefficient of variation shall not exceed 0.10. This shall be deemed to have been met if when four exposures at identical technique factors are made that the value of the average exposure (E) is greater than or equal to five times the maximum exposure (E_{max}) minus the minimum exposure (E_{min}). $E > 5 (E_{max} - E_{min})$

F. Operating Controls:

(1) Patient and film holding devices shall be used when the techniques permit. The safety rules, required by 602.A.1.d [Subparagraph (d), Paragraph (1), Subsection A., Section 602 of 20.3.6.602 NMAC], shall list individual projections where holding devices cannot be utilized.

(2) Neither the tube housing nor the position indicating device shall be hand-held during an exposure.

(3) The x-ray system shall be arranged and operated in such a manner that the useful beam at the patient's skin does not exceed the dimensions specified in 606.B.1.a or 606.B.1.b [Subparagraphs (a) or (b), Paragraph (1), Subsection B., Section 606 of 20.3.6.606 NMAC].

(4) Dental fluoroscopy shall be prohibited.

[5-3-95; 20.3.6.606 NMAC – Rn, 20 NMAC 3.1.6.606, Recompiled xx/xx/xx]

20.3.6.607 THERAPEUTIC X-RAY INSTALLATIONS:

A. Equipment:

(1) The protective tube housing shall be of therapeutic type.

(2) Permanent diaphragms or cones for collimating the useful beam shall afford the same degree of protection as the tube housing. Adjustable or removable beam-defining diaphragms or cones shall transmit not more than five percent of the useful beam at the maximum kilovoltage and with maximum treatment filter.

(3) Filters shall be secured in place to prevent them from dropping out during treatment. The filter slot shall be so constructed that the radiation escaping through it does not exceed 1 R (0.258 mC/kg) per hour at 1 m (3.28 feet), or, if the radiation from the slot is accessible to the patient, 30 R (7.74 mC/kg) per hour at 5 cm (1.96 inches) from the external opening. Each removable filter shall be marked with its thickness and material.

(4) A filter indication system shall be used on all therapy machines using changeable filters. It shall be designed so as to permit easy recognition of any added filter in place. It shall indicate, from the control panel, the presence or absence of any filter.

(5) The x-ray tube shall be so mounted that it cannot turn or slide with respect to the housing aperture.

(6) Means shall be provided to immobilize the tube housing during stationary portal treatment.

(7) A device (e.g., an automatic timer exposure meter or dose meter) shall be provided to terminate the exposure after a preset time interval or preset exposure of dose limit. Means shall be provided for the operator to terminate the exposure at any time.

(8) Equipment utilizing shutters to control the useful beam shall have a shutter position indicator on the control panel.

(9) The control panel shall include a device (usually an ammeter) which will give positive indication of the production of x-rays whenever the x-ray tube is energized.

B. Structural Shielding:

(1) All walls, floors, and ceilings that can be struck by the useful beam shall be provided with primary barriers to the height of the ceiling. Low-voltage superficial therapy units only require a height of 2.1 m (6.88 feet).

(2) All walls, floors, and ceilings that, because of restrictions in the orientation of the useful beam, cannot be struck by the useful beam shall be provided with secondary barriers to a minimum height of 2.1 m (6.88 feet).

(3) With equipment operating at voltages above 50 kVp, the required barriers shall be an integral part of the building.

(4) With equipment operating above 150 kVp, the control panel shall be within a protective booth equipped with an interlocked door, or located outside the treatment room.

(5) Interlocks shall be provided for x-ray therapy equipment capable of operating above 150 kVp so that, when any door of the treatment room is opened, either the machine will shut off automatically or the radiation level within the room will be reduced to an average of not more than 2 mR (20 mSv) per hour and a maximum of 10 mR (100 mSv) per hour at a distance of 1 m (3.28 feet) in any direction from the target. After such shutoff or reduction in output, it shall be possible to restore the machine to full operation only from the control panel.

(6) Windows, mirror systems, or closed-circuit television viewing screen shall be provided to permit continuous observation of the patient during irradiation and shall be so located that the operator may see the patient and the control panel from the same position.

(7) Provision shall be made for oral communication with the patient from the control room.

(8) Treatment rooms to which access is possible through more than one entrance shall be provided with flashing warning lights in a readily observable position near the outside of all access doors, which will indicate when the useful beam is "on".

C. Operating Procedure:

(1) All new facilities, and existing facilities not previously surveyed, shall have a protection survey made by, or under the direction of a qualified expert. This also shall be done after any change in the facility which might produce a radiation hazard. The expert shall report his findings in writing to the person in charge of the facility and a copy of this report shall be transmitted to the Department.

(2) The facility shall be operated in compliance with any limitations indicated by the protection survey.

(3) When a patient must be held in position for radiation therapy, mechanical supporting or restraining devices shall be used whenever feasible. If the patient must be held by an individual, that individual shall be adequately protected and shall be positioned so that no part of the body will be struck by the useful beam and that the body is as far as possible from the edge of the useful beam. The exposure of any individual used for this purpose shall be monitored.

(4) The output of each therapeutic x-ray machine shall be calibrated by, or under the direction of, a qualified expert. The calibration shall be repeated after any change in or replacement of components of the x-ray generating equipment which could cause a change in x-ray output. Check calibrations shall be made at least once a year thereafter. Records of calibration shall be maintained by the registrant.

[5-3-95; 20.3.6.607 NMAC – Rn, 20 NMAC 3.1.6.607, Recompiled xx/xx/xx]

20.3.6.608 SPECIAL REQUIREMENTS FOR X-RAY THERAPY EQUIPMENT OPERATED AT POTENTIALS OF 60 kVp AND BELOW:

A. Equipment: All provisions of 607.A [Subsection A., Section 607 of 20.3.6.607 NMAC] apply except that the leakage radiation 5 cm (1.96 inches) from the surface to the tube housing shall not exceed 0.1 R/hr.

B. Operating Procedures:

(1) Automatic timers shall be provided which will permit accurate presetting and termination of exposures as short as one second.

(2) In the therapeutic application of apparatus constructed with beryllium or other low-filtration windows, the registrant shall ensure that the unfiltered useful beam is blocked at all times except when actually being used.

(3) Machines having an output of more than 1,000 R (100 Bq) per minute at any accessible place shall not be left unattended without the power being shut off at the main disconnect switch in addition to the control panel switch.

(4) The tube-head shall not be hand-held during x-ray therapy.

[5-3-95; 20.3.6.608 NMAC – Rn, 20 NMAC 3.1.6.608, Recompiled xx/xx/xx]

20.3.6.609 VETERINARY MEDICINE RADIOGRAPHIC INSTALLATIONS:

A. Equipment:

- (1) The protective tube housing shall be of diagnostic type.
- (2) Diaphragms or cones shall be provided for collimating the useful beam to the area of clinical interest, and shall provide the same degree of protection as is required of the housing.
- (3) The total filtration permanently in the useful beam shall not be less than 0.5 mm aluminum equivalent for machines operating up to 50 kVp, 1.5 mm aluminum for machines operating between 50-70 kVp, and 2.5 mm aluminum equivalent for machines operating above 70 kVp.
- (4) A device shall be provided to terminate the exposure after a preset time or exposure.
- (5) A dead-man type of exposure switch shall be provided, together with an electrical cord of sufficient length, so that the operator can stand out of the useful beam and at least 1.8 m from the animal during all x-ray exposures.

B. Structural Shielding: All wall, ceiling, and floor areas shall be equivalent to or provided with applicable protective barriers as required in 602.B.1 and 602.B.2 [Paragraphs (1) and (2), Subsection B., Section 602 of 20.3.6.602 NMAC].

C. Operating Procedures:

- (1) The operator shall stand well away from the useful beam and the animal during radiographic exposures.
 - (2) No individual other than the operator shall be in the x-ray room while exposures are being made unless such individual's assistance is required.
 - (3) When an animal must be held in position during radiography, mechanical supporting or restraining devices should be used. If the animal must be held by an individual, that individual shall be protected with appropriate shielding devices, such as protective gloves and apron, and he shall so positioned that no part of his body will be struck by the useful beam. The exposure of any individual used for this purpose shall be monitored.
- [5-3-95; 20.3.6.609 NMAC – Rn, 20 NMAC 3.1.6.609, Recompiled xx/xx/xx]

20.3.6.610 APPENDIX A. INFORMATION ON RADIATION SHIELDING REQUIRED FOR PLAN REVIEWS:

A. In order for the Department to provide evaluation, technical advice and official approval on shielding requirements for a radiation installation, the following information is needed:

- (1) normal location of the radiation producing equipment's radiation port; port's travel and traverse limits; general direction(s) of the radiation beam; locations of all windows; locations of the operator's booth; location of the equipment's control console; distance from x-ray tube to nearest primary barrier;
- (2) structural composition and thickness of all walls, doors, partitions, floor(s), and ceiling(s) of room(s) concerned;
- (3) height, floor-to-floor, of room(s) concerned;
- (4) type of occupancy of all adjacent areas inclusive of space above and below the room(s) concerned; for exterior walls, distance to the closest existing occupied area(s);
- (5) kVp (Kilovolt Peak Potential) and maximum mA (milliamperage) for each radiation machine; and
- (6) type of examination(s) or treatment(s) performed with equipment (e.g., dental, orthodontal, chest, gastrointestinal, fluoroscopic, podiatry, fixed therapy, rotational therapy, etc.).

B. Information on anticipated workload used in shielding calculations must be provided. This must include for each radiation machine number of exposures/week and average duration of each exposure.

C. If services of a qualified radiation expert have been utilized, a copy of his report shall be submitted with plans. This report must show all basic assumptions (i.e., workload, occupancy and use factors, distance, etc.) used to determine the shielding requirements.

[5-3-95; 20.3.6.610 NMAC – Rn, 20 NMAC 3.1.6.610, Recompiled xx/xx/xx]

20.3.6.611 APPENDIX B. MINIMUM DESIGN REQUIREMENTS FOR AN X-RAY MACHINE OPERATOR'S BOOTH:

A. Space Requirements:

- (1) The operator shall be allotted not less than 0.7 square m (7.5 square feet) of unobstructed floor space in the booth.

(2) The minimum space as indicated above may be any geometric configuration with no dimension of less than 61 cm (2 feet).

(3) The space shall be allotted excluding any encumbrance by the console, such as overhang or cables, or other similar encroachments.

(4) The booth shall be located or constructed such that unattenuated direct scatter radiation originating on the examination table or at the wall cassette not reach the operator's station in the booth.

(5) The booth walls shall be at least 2.1 m (7 feet) high and shall be permanently fixed to the floor or other structure as may be necessary.

(6) When a door or movable panel is used as an integral part of the booth structure, it must have a permissive device which will prevent an exposure when the door or panel is not closed (this type of booth structure is not recommended).

B. Switch Placement:

(1) The operator's switch for the radiographic machine shall be fixed within the booth.

(2) The switch shall be at least 1 m (40 inches) from any edge of the booth wall which is proximal to the examining table.

(3) The switch shall allow the operator to use the majority of the available viewing windows.

C. Viewing System Requirements:

(1) Each booth shall have a least one viewing device which will:

(a) be so placed that the operator can view the patient during any exposure; and

(b) the device shall be so placed that he can have full view of any occupant of the room and should be so placed that he can view any entry into the room; and if any door, which allows access to the room, cannot be seen from the booth, then that door must have a permissive device controlling the exposure which will prevent the exposure if the door is not closed.

(2) When the viewing system is a window:

(a) it shall have a visible area of at least 930 square cm (1.5 square feet);

(b) the distance between the proximal edge of the window and the open edge of the booth shall not be less than 45.7 cm (18 inches); and

(c) the glass shall have the same lead equivalence as that required in the booths' wall in which it is to be mounted.

(3) When the viewing system is by mirrors, the mirror(s) shall be so located as to accomplish the general requirements as in above.

(4) When the viewing system is by electronic means (e.g., TV, etc.):

(a) the camera shall be so located as to accomplish the general requirements of 611.C.1 [Paragraph (1), Subsection C. Section 611 of 20.3.6.611 NMAC]. above; and

(b) there shall be an alternative viewing system as a back-up for electronic failure. [5-3-95; 20.3.6.611 NMAC – Rn, 20 NMAC 3.1.6.611, Recompiled xx/xx/xx]

20.3.6.612 APPENDIX C. X-RAY FILM DEVELOPING: Time Temperature Chart:

Thermometer Readings Minimum Developing Times (Minutes)

C	F	
27	80	2.0
	79	2.5
	78	2.5
	77	3.0
	76	3.0
24	75	3.0
	74	3.5
	73	3.5
	72	4.0
22	71	4.0
	70	4.5
	69	4.5
	68	5.0
20	67	5.5

	66	5.5
	65	6.0
18	64	6.5
	63	7.0
	62	8.0
	61	8.5
16	60	9.5

A. Processing of Film: All films shall be processed in such a fashion as to achieve adequate sensitometric performance. This criterion shall be adjudged to have been met if either of the following items can be met:

- (1) film manufacturers' published recommendations as regards time and temperature are followed; or
- (2) each film shall be developed in accord with the time temperature chart.

B. Manual Processing of Film:

(1) Where film is developed manually, a system shall be available which consists of at least one three-sectional tank made of mechanically rigid, corrosion-resistant material (each section of which shall be constructed so as to retain its solution separation from the other two) and has the overall temperature-controlling capability of maintaining each solution such that the temperature of each solution will always fall within the range of 16 C to 27 C (60 -80 F).

(2) Devices shall be available which will:

- (a) give the actual temperature of the developer; and
- (b) give an audible or visible signal, after a preset time (in minutes of duration).

(3) Chemical-Film Processing Control:

(a) Chemicals shall be mixed in accord with the chemical manufacturer's recommendations.

(b) Developer replenisher shall be periodically added to the developer tank based on the area of the films which have been developed (e.g., 1 liter per 3100 in2 of film or in accord with the recommendations of the chemical manufacturer). Solution may be removed from the tank to permit the addition of an adequate volume of replenisher.

(c) All processing chemicals shall be completely replaced at least every 3 months.

(d) At the time of the complete processing chemical change, a film shall be exposed to a density of approximately one, with one-half of the film being protected from the exposure. After full development, it will be maintained in the darkroom or vicinity and at the beginning of each work day at least one test film or film strip (exposed under techniques identical with those used for the original test film) shall be compared with the original test film to evaluate the adequacy of developing results and base fog level.

C. Automatic Processors and Other Closed Processing Systems:

(1) Preventive maintenance shall be performed on the unit, except for extended periods of nonuse, on a frequency basis which is not less than that schedule recommended by the manufacturer. In the event that no schedule is available from the manufacturer a maintenance schedule shall be established which will preserve good film quality.

(2) After a full cleansing of the processor, a film shall be exposed to a density of approximately one, with one-half of the film protected from exposure. It will be developed and then kept near the unit and daily at least one test film (exposed under techniques identical with those used for the original test film) shall be compared with the original test film to evaluate the adequacy of the unit's developing capability and base fog level.

D. Darkrooms:

(1) Darkrooms shall be constructed so that film being processed, handled, or stored will be exposed only to light which has passed through a safe-light filter.

(2) The radiance and spectral emission of the safelight (bulb and filter combination) shall be such that film shall not be "fogged" above the base level when exposed for 1 minute at a distance of about 120 cm from the lamp(s). Film manufacturer's recommendations for a safelight and its placement shall be adjudged to meet this criterion.

[5-3-95; 20.3.6.612 NMAC – Rn, 20 NMAC 3.1.6.612, Recompiled xx/xx/xx]

20 NMAC 3.1.6.613-699 [RESERVED]

HISTORY OF 20.3.6 NMAC:

Pre-NMAC History: The material in this Part was derived from that previously filed as follows: EIB 73-2, Regulations for Governing the Health and Environmental Aspects of Radiation filed on 7-9-73; EIB 73-2, Amendment 1, Regulations for Governing the Health and Environmental Aspects of Radiation filed on 4-17-78; EIB RPR-1, Radiation Protection Regulations filed on 4-21-80; EIB RPR-1, Amendment 1, Radiation Protection Regulations filed on 10-13-81; EIB RPR-1, Amendment 2, Radiation Protection Regulations filed on 12-15-82; and EIB RPR-1, Radiation Protection Regulations filed on 3-10-89. [7-30-99]

History of Repealed Material: [Reserved]

Other History: EIB RPR 1, Radiation Protection Regulations, filed 03-10-1989 renumbered and reformatted to 20 NMAC 3.1, Radiation Materials And Radiation Machines, filed 04-03-1995. 20 NMAC 3.1, Radiation Materials And Radiation Machines, filed 06-17-1999 internally renumbered and reformatted replaced 20 NMAC 3.1, filed 04-03-1995. The material in this Part was derived from that previously filed as: 20 NMAC 3.1.Subpart 6, X-Rays In The Healing Arts, filed 06-17-99 recompiled as 20.3.6 NMAC, effective 11/27/01.