



ADMINISTRATIVE RULES OF MONTANA



37.14.1022 THERAPEUTIC X-RAY INSTALLATIONS

- (1) The equipment used in therapeutic x-ray installations shall be as follows:
 - (a) The tube housing shall be of therapeutic type. Contact therapy machines shall meet the additional requirement that the leakage radiation at 2 inches from the surface of the housing not exceed 0.1 R/h.
 - (b) Permanent diaphragms or cones used 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 5% of the useful beam obtained at the maximum possible kilovoltage and with maximum treatment filter.
 - (c) The filter system shall be so arranged as to minimize the possibility of error in filter selection and alignment. The filter slot shall be so constructed that the radiation escaping through it does not produce an exposure exceeding 1 roentgen per hour at 1 meter, or, if the radiation from the slot is accessible to the patient, 30 roentgens per hour at 2 inches from the external opening. Each removable filter shall be marked with its thickness and material.
 - (d) A filter indication system shall be used on all therapy machines using changeable filters. It shall indicate from the control panel the presence or absence of any filter and it shall be designed to permit easy recognition of the filter in place.
 - (e) The x-ray tube shall be so mounted that it cannot turn or slide with respect to the aperture. A mark on the housing should show the location of the focal spot.
 - (f) Means shall be provided to immobilize the tube housing during stationary portal treatment.
 - (g) There shall be on the control panel an easily discernible indicator which will give positive information as to whether or not the x-ray tube is energized.
 - (h) A suitable exposure control device shall be provided to terminate the exposure after a preset exposure or dose limit. It shall be designed to preserve its accumulated response in the event of equipment failure during patient treatment. If a timer is used, it should permit accurate presetting and determination of exposure times as short as 1 second.
 - (i) Unless it is possible to bring the x-ray exposure rate to the prescribed value within 5 seconds after the x-ray "on" switch is energized, the tube housing on machines operating below 500 kVp shall be fitted with an "ON-OFF" shutter operated from the control panel and of lead equivalent not less than that of the tube housing. The "ON-OFF" positions of the shutter shall be indicated at the control panel.
 - (j) Mechanical or electrical stops shall be provided on x-ray machines capable of operating at 150 kVp or above to insure that the useful beam is oriented only toward primary barriers.

- (k) Interlocks shall be provided for x-ray therapy equipment capable of operating above 75 kVp so that when any door to the treatment room is opened, either the machine will be shut off automatically or the radiation level within the room will be reduced to an average of not more than 2 mR/hr and a maximum of 10 mR/hr at a distance of 1 meter in any direction from the source. After such a shutoff or reduction in exposure rate, it shall be possible to restore the machine to full operation only from the control panel.
 - (l) The x-ray control circuit shall be so designed that it is not possible to energize the x-ray tube without resetting the x-ray "on" switch at the control panel.
 - (m) X-ray therapy machines shall be provided with a locking device to prevent unauthorized use.
 - (n) When a beam interceptor is provided, it shall transmit not more than 0.1% of the useful beam under any operating conditions. It shall also reduce by the same factor the radiation scattered by the patient through an angle up to 30° from the central ray.
 - (o) When the relationship between the beam interceptor and the useful beam is not permanently fixed, mechanical or electrical stops shall be provided to insure that the beam is oriented only toward primary barriers.
 - (p) Special consideration shall be given to the safety design of x-ray machines with electron beam extraction capability such as linear accelerators.
- (2) Therapeutic x-ray machines shall be structurally shielded as follows:
- (a) All wall, floor, and ceiling areas that can be struck by the useful beam, plus a border of 1 foot, shall be provided with primary protective barriers.
 - (b) All wall, floor, and ceiling areas that, because of restrictions in the orientation of the useful beam, cannot be struck by the useful beam shall be provided with secondary protective barriers.
 - (c) With equipment capable of operation above 75 kVp, the control station shall be outside the treatment room.
- (3) The operating procedures applicable to therapeutic x-ray installations shall be as follows:
- (a) A radiation protection survey of all new installations and existing installations not previously surveyed shall be made by, or under the direction of, a qualified expert. A resurvey shall be made after every change in equipment, workload, or operating conditions which might significantly increase the probability of persons receiving more than the MPD. If, as a result of a radiation survey, supplementary shielding is installed, another survey shall be made in order to confirm the adequacy of the shielding after the modification.
 - (b) The qualified expert shall report his findings in writing, including recommendations for any required corrective measures, to the person in charge of the installation, a copy of which shall be sent to the department. The report shall indicate if a further survey is necessary after corrections have been made.
 - (c) The installation shall be operated in compliance with any limitations indicated by the protection survey.
 - (d) An x-ray therapy machine shall be calibrated by a qualified expert before use for the treatment of patients.

- (e) X-ray therapy equipment capable of operating above 75 kVp shall not be operated routinely until the radiation safety of the installation has been established.
- (f) Both the control panel and the patient shall be kept under observation during exposure.
- (g) When a patient must be held in position for radiation therapy, mechanical supporting or restraining devices shall be used.
- (h) No person other than the patient shall be in the treatment room where the tube is operated at potentials exceeding 75 kVp.
- (i) If the x-ray tube of a contact therapy machine is hand-held during irradiation, the operator shall wear protective gloves and apron. A cap of at least 0.5 mm lead equivalent shall cover the aperture window of the tube housing of such apparatus when the apparatus is not being used.
- (j) Lead, lead rubber, lead foil, etc., used for limiting the field, shall not transmit more than 5% of the useful beam (see Table I) .
- (k) Notwithstanding ARM 37.14.721 , personnel monitoring shall be required for all persons who enter a controlled area.

TABLE I

Thickness of lead required to reduce useful beam to 5%*

Potential	Beam Quality Half Value Layer millimeters	Required Lead Thickness millimeters
60 kVp	1.2 Al	0.10
100 kVp	1.0 Al	0.16
100 kVp	2.0 Al	0.25
100 kVp	3.0 Al	0.35
140 kVp	0.5 Cu	0.7
200 kVp	1.0 Cu	1.0
250 kVp	3.0 Cu	1.7
400 kVp	4.0 Cu	2.3
1000 kVp	3.2 Pb	20.5

2000 kVp	6.0 Pb	43.0
2000 kVcp	14.5 Pb	63.0
3000 kVcp	16.2 Pb	70.0
6000 kV	17.0 Pb	74.0
8000 kV	15.5 Pb	67.0
Cobalt 60	10.4 Pb	47.0

*Approximate values for broad beams. The third column refers to lead or to the required equivalent lead thickness of lead-containing materials (e.g., lead, rubber, lead glass, etc.) .

Authorizing statute(s): Sec. 75-3-201 and 75-3-202, MCA

Implementing statute(s): Sec. 75-3-201, 75-3-202 and 75-3-204, MCA

History: NEW, 1980 MAR p. 1069, Eff. 3/28/80; TRANS, from DHES, 1996 MAR p. 433; TRANS, from DEQ, 2000 MAR p. 189.