GUIDE FOR THE PREPARATION OF OPERATING AND SAFETY PROCEDURES FOR THE

USE OF X-RAY DEVICES IN VETERINARY PRACTICE (excluding fluoroscopy)

This guide is to assist you in establishing procedures that will minimize radiation exposure to employees and the general public. They are provided to comply with regulations enforced by the Iowa Department of Public Health, Bureau of Radiological Health (BRH). The regulations are specified in the Iowa Radiation Machines and Radioactive Materials Rules.

Radiation Safety Officer

A Radiation Safety Officer (RSO) must be designated. The RSO has the responsibility and authority for assuring safe radiation practices are written and followed. The RSO serves as the contact person between the facility and the BRH. All questions and concerns should be addressed to the RSO.

Duties:

1. Write the operating and safety procedures and keep them current.
2. Train staff about radiation hazards and safe working practices using the operating and safety procedures. A radiation safety powerpoint is available on the IDPH website.
3. Train staff on the use of the x-ray equipment and how to reduce radiation exposure.
4. Monitor and retrain staff on safe radiation safety practices, as appropriate.
5. Discuss individual monitoring device readings with staff and identify ways to reduce radiation dose.
6. Report radiation overexposures to IDPH.
7. Verify that the equipment is registered annually with IDPH. Notify IDPH of any changes in equipment or location. If there are changes in the registration such as address or ownership, notice must be sent to the BRH within 30 days of the change. Change of ownership requires a new registration with fees paid by the new owner. Addition of new equipment or replacement of old equipment should also be reported. Changes can be faxed to 515-281-4529.
8. Check protective aprons and gloves annually for damage.
9. Verify that the room shielding meets IDPH requirements.
10. Verify that the x-ray device is working properly.

11. Maintain records required by Iowa Radiation Machines and Radioactive Materials Rules

12. Secure machines from unauthorized use or removal. Report unauthorized use or removal immediately to IDPH.

Training requirements for operators of x-ray machines

Radiation doses to persons involved in veterinary radiography are relatively low in comparison with some health related diagnostic procedures. However, radiation dose can become significant as a result of poor work practices especially when holding animals. It is important to know how to properly use the x-ray equipment in order to use the lowest possible exposure to obtain diagnostic quality images. Digital radiography can allow for significant overexposure without operator awareness because of software based imaging post processing. Therefore, proper training is extremely important.

All operators of x-ray machines must be trained by the RSO to operate the x-ray equipment safely, wear the correct protective devices and individual monitoring devices, process the film properly, and practice good radiation safety. In addition, each individual should be familiar with the potential health problems associated with radiation exposure to individuals and potential offspring and the requirements of the Iowa Radiation Machines and Radioactive Materials Rules.

All staff must acknowledge receipt of training by signing the form on appendix A or a similar record. All operators of x-ray equipment must be able to demonstrate familiarity with the procedures taught in the training.

Individual radiation monitoring requirements

Occupational exposure to radiation is dose received by the vet or employees. Occupational exposure for adults is limited to the following annual doses: (rem is a special unit for measuring radiation dose)

1. Whole body dose of 5 rem .

2. A lens dose of 15 rem.

3. A shallow dose equivalent of 50 rem to the skin of any extremity.

Doses limits for minors (under age 18) is 10% of the annual dose limits for adults shown above.

Doses received while working for other employers should be figured into the total annual dose limit. Employees working at multiple sites for one employer should wear one individual monitoring device or personal dosimetry.

Individual monitoring devices are required for all individuals:

1. Likely to receive 10% of the above doses in one year.
2. Who hold animals.
3. Declared pregnant individuals.

Types of individual monitoring devices approved for veterinary radiography:

1. Film badges
2. Thermoluminescent dosimeters (TLDs)
3. Optically stimulated luminescent devices (OSL)

Where to wear individual monitoring devices:

1. If no protective apron is worn, the individual monitoring device should be worn on the body trunk at midline.
2. If a protective apron is worn because the individual needs to be less than 6 feet from the tube or animal, the individual monitoring device should be worn at the collar outside the apron to measure thyroid and eye doses.
3. A declared pregnant individual should wear a second individual monitoring device under the apron at the waist.

Care of individual monitoring devices. The badge:

1. Shall be assigned to and worn only by one individual.
2. Shall be stored away from the x-ray room and excessive heat.
3. Shall be controlled so as to not be exposed to deceptively indicate a false dose to an individual.
4. Should not be worn away from the workplace.
5. Should not be placed in high temperatures (car dash or clothes dryer).

Frequency of personal monitoring readings:

Personal monitoring devices may be returned to the provider company for reading on a monthly or quarterly frequency or read on a predetermined schedule by a computer program supplied by the provider company.

Records of employee exposure

1. A copy must be given to each employee after each reading.
2. A copy must be retained even after the employee has left.
3. Exposures exceeding the annual limits must be reported to IDPH within 30 days of the discovery of the exposure. The report must in include a copy of the exposure report, the cause of the exposure, and corrective actions taken or planned to prevent future occurances.

Protective lead aprons and gloves

Protective devices are worn to reduce exposure to radiation and keep radiation exposure as Low As Reasonably Achievable (ALARA). Lead gloves must completely surround the hand.

1. Lead aprons with lead equivalence of at least 0.25 mm must be available for all persons involved in radiography when they are required to hold an animal.
2. Lead gloves with lead equivalence of at least 0.5mm must be available for all persons involved in radiography when they are required to hold an animal.
3. Lead aprons, collars, and gloves should be stored without folding to help prevent the formation of cracks.
4. Lead aprons, collars, and gloves should be checked annually for defects, such as holes, cracks, or tears. This check can be done by x-raying the protective device. A record of the check should be kept. All defective aprons, collars, or gloves should be replaced immediately.

General x-ray machine operation

1. When using a stationary unit, the individual making the exposure should be able to stand at least 6 feet away from the x-ray unit if the individual is not restraining the animal.
2. Do not hold the x-ray tube head during exposures.
3. The primary beam should be reduced to the area to be examined by means of the collimator.
4. Screens in the cassettes and the type of film must be compatible.

5. The lowest possible exposure settings should be used in digital systems because the image processing software is capable of producing diagnostic quality images even when using exposure factors lower than those used with film.

6. Learn how to adjust the x-ray controls to get the same results by reducing the exposure time.

7. Plan ahead to reduce repeat exposures.

8. Exposure techniques must not be adjusted to compensate for inadequate film processing.

9. No individuals shall be in the room unless their assistance is required.

10. Doors to the x-ray room must be closed during the radiographic examination. If the doors cannot be closed, the operator must be able to control access to the room.

11. Adjacent rooms should be empty unless additional wall shielding allows for occupancy.

12. All machines should be protected against unauthorized use and stored to prevent unauthorized removal.

Holding animals and/or film

1. Use mechanical holding devices, restraining molds, sandbags, or sedation whenever possible.

2. No individual shall hold a film or film cassette. A cassette/screen holder shall be used whenever a cassette/screen cannot be supported by a table or another support.

3. All body parts should be out of the direct beam including hands covered with gloves.

Use of Hand-held veterinary radiographic unit

These requirements are the minimum requirements for veterinary radiographic units designed to be operated as a hand-held unit either in the facility or in the field. Equipment owners must commit to the following:

1. Operators shall operate the unit according to the manufacturer's instructions.
2. The unit shall not be operated unless the backscatter shield is in its proper place if the unit is provided with one.
3. The unit shall be operated on a stand or tripod whenever possible.
4. No individual may be within a radius of at least six feet from the animal during exposures unless holding the animal.

5. Move out of the line with the direct beam. Stand to the side as far away from the direct beam as possible.
6. Do not hold the cassette with your hands or body. Use a film holder.
7. The unit shall not be operated in hallways and waiting rooms.
8. Operators shall wear protective shielding of at least 0.25 mm lead equivalence to protect the eyes and thyroid while operating the unit.
9. Operators who cannot stand directly behind the unit backscatter shield in the safe zone when making exposures must wear protective lead aprons. All individuals holding an animal must wear a protective lead apron and gloves during the exposure.
10. Operators shall wear personal monitoring, such as a film badge, to monitor eye exposure. Monitoring may be monthly or quarterly.
11. A separate log shall be kept of the date and number of exposures per animal taken by each operator for the hand-held unit. Comments should be included for problems with difficult positioning.
12. When not in use, the unit shall be stored to prevent inadvertent exposures or use by unauthorized individuals.
13. The unit shall be exempted from the restriction requirements of 641-41.1(3)"a"(9)"3", the plan review requirements of 641-41.1(3)"d"(1) (unless the unit will be used inside the facility also), and the tube-head holding restrictions of 641-41.1(7)"h"(2).

Film processing and storage

1. Film processing must be in accordance with the manufacturer's recommendations.

2. Unexposed x-ray film must be stored in accordance with the manufacturer's recommendations, in a container away from excessive heat, humidity, or chemical contamination and away from accidental exposure during radiography.

3. Darkroom fog tests should be performed on a regular basis. Procedure for the testing is located in Appendix C to this guide.

Dedicated X-ray room shielding

In general, the requirement is to limit primary and scatter radiation to acceptable levels. In general,

1. No additional shielding is needed for walls that are also outside building walls (walls that are shared with another business are not outside walls.

2. If an area next to the x-ray room is occupied during exposures, the wall between the two rooms must have 1 ½ inches of sheetrock.

3. If the area next to the x-ray room in not occupied during exposure, no additional shielding is necessary.

4. If your unit allows and you plan to do standing laterals with the primary beam pointed at a wall bordering an occupied area, that wall will require some lead shielding. You should contact a health physicist for help. An alternative is to direct the primary beam to a wall bordering an unoccupied area. If the alternative is chosen, the procedure must be written in your radiation safety procedures and included in the training of your staff.

Records to be kept

1. The provisions of the radiation safety program, any audits, reviews, or changes.
2. Individual monitoring device records and incident reports.
3. Training logs.
4. Equipment maintenance logs.
5. Room shielding surveys or evaluations.
6. Results of darkroom fog tests (if applicable).

Emergency procedures

The RSO will be notified immediately :

1. Of any problems with the x-ray equipment.
2. Of any suspected unauthorized exposure to individuals.
3. Of an unauthorized use of the equipment.
4. Of any unauthorized removal of the equipment.
5. Of any problems with protective aprons or gloves.
6. Of any damage or loss of individual monitoring devices.

The RSO will immediately notify the IDPH of 2, 3, and 4 above.

APPENDIX A

REVIEW OF RADIATION SAFETY PROGRAM

Development of these safety procedures is to facilitate safe radiological working conditions. Everyone must adhere to these procedures. For ANY deviation from these procedures, prior approval from the RSO is required.

The RSO has reviewed the radiation safety program content (annually), made any changes necessary, and reviewed the program with all individuals who operate the x-ray equipment.

_____ _____

Signature of Radiation Safety Officer Date

OPERATOR STATEMENT

I have read the procedures and agree to abide by them.

Signatures	Date Reviewed
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

APPENDIX C

HOW TO CONDUCT A FOG TEST

PHANTOM FILM METHOD

1. Load a cassette with the fastest film routinely used in the darkroom. Expose the film-cassette using an appropriate phantom, such as the NEXT adult chest phantom. The facility's clinical technique may be adequate for this test.

NOTE: The radiographic technique used should produce a background film density between 1.0 and 1.8 in order to be sufficiently sensitive to subsequent levels of fog.

2. Use the area in the darkroom that is typically used to handle films in the typical day-to-day operations.
3. Quickly remote the film from the cassette and insert the film into the fog folder so that the short end of the folder with the words "FOG" are on top. The top (short) edge of the fog folder should cut across a region of the film which would otherwise have uniform film density. Also, be certain that the top edge of the fog folder is laying flat against the film.

NOTE: If the film is a single-emulsion type, you should verify that the emulsion is facing upward.

4. Expose the film/fog folder to the darkroom environment for two minutes. Be careful that you are not shading the film from sources of fog during this time.
5. Remove the film from the folder and quickly feed into the automatic processor.
6. Inspect the developed film for the present of a border and the words "FOG". It is recommended that you use a viewbox if the presence of a border is not obvious.
7. If you cannot see a border nor the words "FOG" on the film, then there is no observable fog in the darkroom.
8. If you see a distinct border and the word "FOG" on the film, then:
   a. Select a region along the fog edge near the center of the film that is a region of constant density. You do not want to measure fog levels near features on the film such as test tool images or spinal features such as on the abdomen and pediatric phantoms.
   b. Measure the optical densities on either side of the "FOG" border as near the border as possible. If permissible, you may cut into the film in order to extend the reach of your densitometer.

REMINDER: The optical density of the unfogged area should between 1.0 and 1.8 OD.

c .The difference between the higher optical density (film density WITH fog) and the lower optical density (film density WITHOUT fog) is the NET darkroom fog level.

STEPWEDGE METHOD

1. Load a cassette (preferable 8”x10”) with the fastest film routinely processed in the darkroom.
2. Position the cassette on the tabletop at a 40-inch target-to-film distance.
3. Place an aluminum stepwedge on the center of the cassette with the long dimension of the wedge along the cassette’s long axis.
4. Collimate the light field to the approximate size of the cassette.
5. Expose the cassette using 70 kVp and 5 mAx.
6. Proceed to step 2 under “Phantom Film Method.”

REDUCING DARKROOM FOG

Darkroom fog can be attributed to improper bulb wattage, close safelight positioning, too many safelights, wrong safelight filter for the film processed, aged or damaged safelights, other devices in the room which produce light, or any combination of these factors.

Pre-Approved Radiation Protection Program

Radiation protection programs are used to minimize unnecessary radiation exposure to employees and the general public and to help prevent either group from exceeding the legal limits on radiation exposure. This program has been developed by the IDPH to assist registrants in meeting the Iowa Radiation Machines and Radioactive Materials Rules. If this program described in the Guide is used, it does not need to be submitted to IDPH for review. If alternatives are used, please submit the program to IDPH for review.

The signature below attests that you, the RSO, have evaluated the provisions of this guide and agree they accurately describe the conditions present. All staff members involved in making radiographic exposures must be made aware of this program and held accountable for following it.

You may choose to use the program as described in the Guide or you may make alterations to the program. If you make alterations, you must not only specify the changes but explain the reasons why the alterations were made.

Facility name _____

Radiation Safety Officer _____

Signature of RSO _____Date _____

_____ RSO duties will include all of the items in the Guide. OR

_____ Specify how and why the RSO duties will vary from the Guide.

_____ All staff will be trained according to the Guide. OR

_____ Specify how and why the staff training will vary from the Guide.

_____ All staff will be trained and follow the Guide for wearing and care of individual monitoring devices, OR

_____ Specify how and why the wearing and care of individual monitoring devices will vary from the Guide.

_____ Frequency of individual monitoring device readings will be (circle one):

monthly quarterly

_____ Records for keeping employee monitoring will follow the Guide.

_____ Protective lead aprons and gloves will be worn, stored, and checked according to the Guide, OR

_____ Specify how and why the wearing, storage, and checking of aprons and gloves will vary from the Guide.

_____ X-ray machine operation will follow the procedures of the Guide, OR

_____ Specify how and why the operation of the machine will vary from the Guide.

_____ Holding animals and/or film will follow the procedures of the Guide, OR

_____ Specify how and why the procedures for holding animals and/or film will vary from the Guide.

_____ Film processing and storage will follow the procedures of the Guide, OR

_____ Specify how and why the processing and storage will vary from the Guide.

_____Darkroom fog testing (if applicable) will follow the procedures of the Guide, OR

_____ Specify how and why the procedures for darkroom fog testing will vary from the Guide.

_____ Use of a hand-held unit will follow the procedures of the Guide, OR

_____Specify how and why the hand-held unit procedures will vary from the Guide.

_____ Dedicated x-ray room shielding includes:

_____ No shielding for outside building walls not shared with another business

_____ 1 ½ inches of sheetrock for walls next to occupied areas

_____ No additional shielding because no walls are next to occupied areas

_____ Additional lead in walls where the primary beam is pointed during standing laterals

_____ No additional lead where the primary beam is pointed during standing laterals because the adjacent room is unoccupied during exposures

_____ Written procedures and staff training for pointing the primary beam during standing laterals.

_____ Records will be kept according to the Guide, OR

_____ Specify how and why the record keeping will vary from the Guide.

_____ Emergency procedures will follow the Guide, OR

_____ Specify how and why the emergency procedures will vary from the Guide.

References: Iowa Radiation Machines and Radioactive Materials Rules

641-39.3	(2) Application for registration of radiation machines facilities
	(5) Expiration of notice of registration
	(6) Renewal of notice of registration
	(7) Report of changes
641-40	(10) Radiation protection programs
	(15) Occupational dose limits for adults
	(18) Determination of prior occupational dose
	(22) Dose to an embryo/fetus
	(37) Conditions requiring individual monitoring of external occupational dose
	(55) Security and control of sources of radiation
	(80) Records of radiation protection programs
	(82) Records of surveys
	(84) Records of prior occupational dose
	(86) Records of individual monitoring results
	(95) Reports of stolen, lost, or missing sources of radiation
	(96) Notification of incidents
	(101) Notification and reports to individuals
	(111) Instructions to workers
	(114) Consultation with workers during inspections
	(115) Request by workers for inspections

(116) Inspections not warranted-informal review

(117) Employee protection

641-41 (3) Administrative controls

(10) Veterinary medicine radiographic installations