RADIATION PROTECTION and LASER SAFETY PROGRAM MANUAL

Revised 2022

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Introduction

In the province of Alberta, all diagnostic and therapeutic x-ray equipment, particle accelerators and Class 3B and 4 lasers are governed by the *Occupational Health and Safety* (OHS) *Act* and OHS Code. Compliance with the OHS Act and code is the responsibility of the Ministry of Labour. On December 1, 2021, Alberta labour and immigration moved the Radiation Protection Program under section 59 of the Occupational Health and Safety Act. Alberta Labour and Immigration designated the Alberta Veterinary Medical Association as an Authorized Radiation Health Registration Agency under the Radiation Protection Program.

This manual outlines the responsibility of ABVMA members in complying with radiation safety principles and legislation.

The obligations include:

- registration of all equipment
- development of a Code of Practice for employees ensuring the installation and operation of equipment and facilities comply with required OHS standards
- documentation and implementation of a Quality Control Program for all equipment in use
- appointment of a qualified individual as Radiation Quality Control Officer for each Veterinary Practice Entity (VPE)
- appointment of a qualified individual as Laser Safety Officer for each VPE where class 3b/4 lasers are in use

The principle of achieving “as low as reasonably achievable” (ALARA) radiation dose levels for veterinarians, technologists and other employees is essential to maintain a safe workplace.

1. Standards/Policies

Following is a list of standards which apply to veterinary radiation and laser facilities. This manual consolidates the important information that is required by a veterinary facility. Please note that it is the **owner's** responsibility to ensure the equipment and facility comply with the requirements.

1. The new *OHS Act* is effective December 1, 2021
   This is the provincial legislation which documents high level responsibility.

2. The revised OHS Code is effective December 1, 2021
   This is the provincial legislation which specifies the requirements to be met. For radiation requirements, including the need for an employer to have a registration certificate for their designated radiation equipment, see the revised Part 20 as well as the new Schedule 12.

3. Health Canada Safety Code 28
   This is federal legislation which specifies the requirements to be met with regards to structural shielding design for medical and veterinary x-ray installations.

4. ABVMA Practice Inspection/Practice Standards Bylaw
   Refer to Service Categories 8 and 9

5. ANSI Z136.1 2014 Safe Use of Lasers
   American National Standard for Safe Use of Lasers

6. Dental X-ray Safety Code 30
   This is federal legislation which specifies the requirements for dental x-ray units.

7. Health Canada Safety Code 35
   Safety Procedures for the installation, use and control of x-ray equipment in large medical radiological facilities

8. Information on how to report and complete an OHS investigation report is available at:
   https://www.alberta.ca/report-serious-injuries-incident.aspx

2. Registration of X-ray and Laser Equipment

An employer must ensure that no worker operates designated radiation equipment unless a registration certificate has been issued by an authorized radiation health registration agency (ARHRA). The ABVMA is the ARHRA for all veterinary practices in Alberta as well as educational facilities offering veterinary and animal health technology programs.

2.1 When to Register

Registration is required in the following situations:
Installation of equipment (new or used) in a new or existing VPE
Relocation of equipment within the VPE or to another location.
Modification of the characteristics of the radiation emitted from the equipment or the protective properties of the facility.

2.2 How to Register

Submit a completed online Application for Registration of Designated Radiation Equipment to the ABVMA office through the VPE Portal.
Contact one of the accredited Authorized Radiation Protection Inspection Agencies (ARPIA) and have them inspect your radiation and laser facility and equipment.
Submit the inspection report to the ABVMA office. Once compliance has been confirmed the ABVMA can certify your equipment and issue a registration certificate for designated radiation equipment.

***Equipment must not be operated until a registration certificate is obtained**, w*ith the exception of an ARPIA agent using the equipment to do testing.

2.3 Owner Update

The owner(s) of the VPE is responsible for ensuring that all obligations under the OHS Act and Code, and Practice Inspection and Practice Standards Bylaws of the ABVMA are met. The ABVMA must be notified when the owner(s) of the VPE changes.

2.4 Fees

The annual registration fee for confirmation of existing equipment and the registration of any new equipment will be assessed on a VPE rather than on an equipment basis. The fee will be charged on an annual basis to existing VPEs and at the time of opening a new VPE.

2.5 Compliance Verifications

Compliance verifications of x-ray equipment, class 3b/4 lasers and VPEs must be performed by an Authorized Radiation Protection Inspection Agency prior to certification and ***renewed every five years or when equipment is moved or modified.***

A compliance verification should also be considered when there is a sudden increase in the workload since the last verification or when the use of an adjacent room (in floors above and below included) changes.

Verifications ensure that:

- the facility is in compliance with current legislation
- equipment has been installed correctly and is functioning properly
- shielding has been calculated and installed correctly
- the principle of “as low as reasonably achievable” (ALARA) has been utilized within the VPE design
- a quality assurance program is in place

The Authorized Radiation Protection Inspection Agency will complete a Compliance Verification Report on your facility and equipment. This report must be submitted to the ABVMA. This is required to be done every 5 years.

The owner of the equipment is responsible for:

- arranging for the compliance verification by an Authorized Radiation Protection Inspection Agency
- paying for the Compliance Verification
- ensuring that the final report is forwarded to the ABVMA *(note: the final report is not forwarded to the ABVMA until the ARPIA invoice is paid)*

To assist the owner with obtaining the services of an Authorized Radiation Protection Inspection Agency, a list of these agencies is provided at the end of this Section.

2.6 Maintaining Registration of diagnostic imaging equipment and lasers

Completion of the Radiation Quality Control Program section of the annual VPE online renewal and payment of the Annual Radiation Registration Fee to the ABVMA, and

Having a full Compliance Verification performed by an Authorized Radiation Protection Inspection Agency every five (5) years.

Listing of Authorized Radiation Protection Inspection Agencies

3. Code of Practice for Employees: (Worker Safety)

A "Code of Practice" means a document prepared by an owner or employer to provide information to workers and other persons concerning the safe operation of radiation facilities, radiation and laser equipment or radiation sources, including the following:

a. practical guidance on the requirements of the OHS Act and Code, Safety Code 28 and ABVMA Bylaws.
b. safe working and operating procedures.
c. actions to be taken in emergency situations.
d. other matters required by the OHS Act/Code or the government of Alberta Director
e. The responsibilities of the owner or employer to:
    - establish a code of practice
    - ensure that the code of practice is readily available to workers and other persons, and
    - upon request, supply a copy of the code of practice to the government of Alberta Director, OHS officer or the PIPS inspector for review.
f. The responsibilities of the x-ray worker to:
    - wear PPE correctly
    - stay as far away from the primary beam as possible and look away from the beam when taking the exposure
    - Use hands-free techniques and minimal manual restraint as much as possible
    - plan ahead to reduce repeat images having to be taken i.e., proper settings, positioning
g. If there has been an exposure above the dose limits described in the Occupational Health and Safety (OHS) Code, or the incident resulted in the death or hospitalization of a worker, the employers is expected to:
    - report the incident to OHS as required under section 33(4) of the *OHS Act* as soon as possible as per the procedure outlined in this bulletin, providing all required information
    - carry out an investigation and prepare a report as required under section 33(6) of the *OHS Act*; and
    - initiate any necessary corrective measures including ensuring a worker is not continuing to be exposed to radiation beyond the exposure limits as specified in the OHS Code.

Information on how to report and complete an investigation report is available at https://www.alberta.ca/report-serious-injuries-incident.aspx

3.1 Physical Facility

Design: The radiology area should be designed in a safe yet effective manner. Veterinary facilities must have a room dedicated to radiography to minimize traffic. Design should include consideration of traffic and adjacent room uses. The x-ray machine and control panel should be located with safety as well as convenience in mind.

Construction: Safe construction must take into account walls, doors, floors and ceilings; adjacent room use; and workload. An Authorized Radiation Protection Inspection Agency should be consulted prior to and during construction of a radiology facility.

A room safely constructed for one x-ray machine may not be adequate for newer equipment of higher capacity.

Changes in workload may also necessitate room modifications.

3.2 Standard Operating Procedures

Each veterinary practice that has x-ray and/or laser equipment must have standard operating procedures (SOPs) that include safe work practices and a description of the quality control tests that will be performed in the veterinary practice to assure a safe work site.

3.3 Protective Clothing and Devices

X-Ray Equipment

Apron, full hand gloves and thyroid protectors must be used for workers involved in the holding of patients.

PPE:
Protective clothing is designed to protect workers from scatter radiation. The hospital must have two aprons (of 0.5mm LE), two pairs of full hand gloves (of 0.5mm LE) and two Thyroid protectors (of 0.5mm LE) available. Labels and tags must never be removed from any PPE. The label/tag contains important information regarding the lead equivalent thickness. It is important that each PPE item is uniquely identified to track quality testing of the item. Lead protective PPE has a life expectancy and manufacturer recommendations should be followed.

Usage:
Manual restraint of animals should be avoided whenever possible. The animal should be sedated or restrained using positioning devices during x-rays.

In cases where manual restraint cannot be avoided, the use of protective apron, gloves and thyroid protector must be used by the operator(s).

Staff should be discouraged from regularly manually holding patients for x-rays.

Storage:
All protective equipment must be stored according to the manufacturer's recommendations.

<u>Aprons</u>
Aprons must not be folded or crumpled since cracks will develop in the lead lining which will decrease protection. Lead aprons should be hung. The aprons must be periodically evaluated for cracks or tears by taking radiographs of the aprons.

<u>Gloves</u>
Leaded full hand gloves must always be worn by any person manually restraining a patient during a radiographic exposure. Gloves with 0.5 mm lead equivalent are required.

Gloves only protect the wearer from scatter radiation and do not protect the wearer from the primary beam. Even with leaded gloves, the hands must not be included in the primary beam. Scattered radiation from the patient and table is the hazard to the holder. Therefore, the practice of draping/laying gloves over the top of bare hands while holding the patient is not acceptable.

Lead gloves with holes or tears offer less protection of the hand. Gloves must be periodically evaluated for such defects by manual examination. The service life of gloves can be extended by proper storage (fingers up on specific holder) and by the use of glove liners.

<u>Cassette holders</u>
Cassette holders are devices used to hold and fix the cassette in a desired position and thus avoid hand holding a cassette during a radiographic exposure. Since the table supports the

cassette with most vertical beam work, their primary application is in horizontal beam work. They must be used whenever possible. Hand holding cassettes is prohibited.

Lasers (3b and 4)

Eye protection
Eye protection is required for everyone within the optical hazard distance of the laser to prevent harmful exposure from reflected and scattered laser beams. Select CSA approved eyewear. Laser safety eyewear will indicate an OD (optical density) at a specified wavelength. Eyewear must meet the minimum requirements as outlined by the manufacturer.

Skin protection
Personnel must take measures to reduce the exposure of unprotected skin. Protective clothing and gloves are required that meet the manufacturer's recommendations for the laser unit.

3.4 Dosimetry

All operators of X-ray equipment, together with personnel who participate in radiological procedures must wear personal dosimeters.

The personal dosimeter must be worn **underneath** the apron.

Where irradiation to the body may be substantial, a second personal dosimeter located at the neck level may be worn. In such cases consultation with the proper federal or provincial agency may be helpful. If extremities are likely to be exposed to higher doses (C-Arm, Fluoroscope) additional monitors *should* be worn on the extremities.

All dosimetry badges must be used and monitored as required by the Alberta OHS bulletin *Personal Exposure Monitoring for Ionizing Radiation (dosimetry)*. Employers must provide workers with a personal dosimeter to monitor exposure when workers use or are involved in the use of ionizing radiation equipment or an ionizing radiation source. The personal dosimeter must be supplied by a dosimetry service provider licensed by the Canadian Nuclear Safety Commission.

OHS Safety Code, Part 20

291.5(1) *An employer must ensure that*
(a) a worker who uses or may be exposed to radiation through the use of any ionizing radiation equipment described in subsection (2) is provided with and uses an appropriate device, provided by a dosimetry service provider licensed by the Canadian Nuclear Safety Commission, to monitor the worker's personal exposure to ionizing radiation,
(b) the records obtained from the monitoring are kept for at least 5 years,
(c) affected workers are informed of and have access to their personal exposure records, and
(d) the dose of a worker as determined by monitoring pursuant to clause (a) is reported to the National Dose Registry

291.6(1) *If an employer is informed by a worker that the worker is pregnant, the employer must reassess the worker's employment duties or training activities, as the case may be, and modify the duties or activities, where reasonable to do so, to ensure that the worker's effective dose of ionizing radiation does not exceed the applicable maximum effective dose limits specified in Table 1 of Schedule 12.*

291.6(2) An employer must not allow a worker under the age of 18 years to use or be involved in the use of ionizing designated radiation equipment or an ionizing radiation source except where:
(a) the worker is a student undergoing a course of instruction involving the use of such equipment or source, and

(b) the use forms part of that course and is conducted under the direct supervision of a competent worker

All radiation workers employed at multiple locations must be provided a dosimetry badge by their employer for each location that they are working at.

Pregnant workers who continue to be involved with x-rays, should be encouraged to practice hands-free radiography and increase their distance from the x-ray source during exposure.

Occasional assistants, such as students can use a "Guest/Visitor" dosimeter, which will then be submitted to Health Canada to be read. The practice must keep a log of who used the guest/visitor dosimeter badge on what dates.

Dosimeters must remain in the clinic when not being worn and need to be protected from light. They should be stored in a drawer in the treatment area away from radiation sources and so that the Radiology Quality Control Officer can access them when needed.

Dosimeters should be worn throughout every day worked. This will measure any exposure a staff member may have, even if they are not engaged in the radiation area.

Further information is available in the Alberta OHS bulletin: Personal Exposure Monitoring for ionizing radiation(dosimetry)

Authorized Dosimetry Service Providers

National Dosimetry Services
Health Canada
775 Brookfield Road, Address Locator 6301D
Ottawa, Ontario K1A 1C1
Phone: 1-800-261-6689
Fax: 1-800-252-6272
E-mail: hc.nds-snd.sc@canada.ca
Website:https://www.canada.ca/en/health-canada/services/dosimetry/about.html

Landauer Inc.
2 Science Road Glenwood, Illinois USA 60425-1586
Phone: 1-800-323-8830
1-708-755-7000
Fax: 1-708-755-7016
Email: custserv@landauer.com
Website: https://www.landauer.com

Mirion Technologies Dosimetry Services
104 Union Valley Road
Oak Ridge, Tennessee, USA 37830
Phone: 1-800-251-3331
E-mail: dsd-support@mirion.com
Website: https://www.mirion.com/dosimetry-services

3.5 Consideration of Hands-Free Radiography

Hands-free techniques for radiography refer to the use of non-manual restraint of animals during x-rays. Hands-free techniques can be achieved through the use of positioning devices such as loosely filled sandbags, foam troughs, elastic extremity straps, etc. The use of these devices allows for the operator to create additional distance from the x-ray source during exposure, within the room or out of the room, when safe to do so. This will reduce the operator's exposure to ionizing radiation as well as reduce the number of workers in the x-ray room.

Options for purchasing positioning devices:
www.handsfreexrays.com
www.techno-aide.com
www.vetxray.com
www.pattersonvet.com

3.6 Protection of Pregnant Workers

Women of childbearing age have an additional risk due to the hazards of radiation for the developing embryo/fetus. These individuals must receive specific information outlining the current regulations and recommendations for women of childbearing age in radiation occupations.

These requirements are outlined in the Alberta OHS Code, section 291.6:
291.6(1) If an employer is informed by a worker that the worker is pregnant, the employer must reassess the worker's employment duties or training activities, as the case may be, and modify the duties or activities, where reasonable to do so, to ensure that the worker's effective dose of ionizing radiation does not exceed the applicable maximum effective dose limits specified in Table 1 of Schedule 12.

Pregnant workers who continue to be involved with x-rays should be encouraged to practice hands-free radiography and increase their distance from the x-ray source during exposure.

3.7 Training

In accordance with the OHS Code, Part 20, section 291:
Prevention and protection
If a worker may be exposed to ionizing radiation at a work site, an employer must
(a) develop and implement safe work practices and procedures to be used when the worker works with or approaches the radiation source,
(b) if practicable, involve affected workers in the development and implementation of the safe work practices and procedures, and
(c) inform affected workers of the potential hazards, including reproductive hazards, of ionizing radiation and the radiation source and the precautions to be taken to protect the workers and other persons from those hazards.

In addition, owners of x-ray equipment are expected to provide positioning tools and training promoting ALARA with emphasis on distance from the x-ray source during exposure.

3.8 Records and Logs

Adequate records must be maintained to document important information and maintain consistency.

a. Radiology Log

The PIPS Bylaw states: *A hard copy or computerized radiographic log for all radiographs (including dental radiographs) is maintained. The radiographic log includes the following:*
Owner/patient identification
Exposure technique information (kVp, mAs, MA) (not required for automated digital systems)

Body part thickness (where applicable) (not required for automated digital systems)
*Number of exposures, diagnostic and non-diagnostic**
Names of individual(s) who took the exposure and/or restrained

This information allows for the following:
Reproducibility
Accurate corrections of exposure errors
Documentation of workload of the x-ray machine
Documentation of exposure of personnel

* For digital radiography, rejected images must be recorded and then the rejected images can be deleted.

Back up files which allow recovery of backed up files, or otherwise protects against loss of, damages to and accessibility of information of all medical records are required, including radiology logs, diagnostic images.

b. Dosimetry Records

In accordance with the OHS Code, Part 20, section 291, Monitoring worker exposure to ionizing radiation (dosimetry):

291.5(1) An employer must ensure that

(a)a worker who uses or may be exposed to radiation through the use of any ionizing radiation equipment described in subsection (2) is provided with and uses an appropriate device, provided by a dosimetry service provider licensed by the Canadian Nuclear Safety Commission, to monitor the worker's personal exposure to ionizing radiation,

(b) the records obtained from the monitoring are kept for at least 5 years,

(c) affected workers are informed of and have access to their personal exposure records, and

(d) the dose of a worker as determined by monitoring pursuant to clause (a) is reported to the National Dose Registry

If you are changing dosimetry service companies, ensure that all previous file information on staff is transferred so that cumulative exposure histories are accurate.

c. Quality Control test results

The objective of quality control tests is early identification and prompt corrective action to maintain x-ray image quality.

Quality Control test results must be kept for a minimum of 5 years for comparative purposes. Types of QC tests and frequency of testing are covered later in this document.

For x-ray machines, a repeat analysis monthly calculation is a mandatory part of the practice's quality control program on **all** radiation units, individual to each unit.

Quality Assurance Program for diagnostic x-ray equipment

4.1 Enacting an X-Ray Quality Control Program

Quality Control is defined as the identification of actions necessary to ensure, and then verify, the performance of radiographic equipment. It is part of the over all Quality Assurance Program which documents all the factors relating to policy and procedure in Radiation Safety. An ineffective equipment quality control program/protocol can lead to poor quality x-rays that can impair diagnosis and contribute to unnecessary radiation exposure to both staff and patients.

The owner of the facility, as well as the responsible veterinarian for the veterinary practice entity, is responsible for assigning a Radiation Quality Control Officer, whose role is to ensure the Quality Control tests are run, interpreted and documented at the appropriate frequency. It is the responsibility of the x-ray equipment owner, to ensure these tests are run, not of the licencing agent. The owner must also ensure that any necessary corrective actions are taken.

An appropriate Quality Control Program will result in:

- Diagnostic Quality radiographs providing information for accurate diagnosis
- Lower exposure doses for employees and patients
- Better patient care
- Less repeats

Recommended reference “Lavin’s Radiography for Veterinary Technicians” Seventh Edition, Marg Brown, Lois C. Brown, 2018, Elsevier Inc. ISBN 978-0-323-41367-

Members are referred to this text as well as the ABVMA quality assurance videos (see links below) for details on how to perform specific tests.

4.2 Quality Control Tests

The goal of quality assurance tests is to isolate and correct potential problems and to detect changes in x-ray equipment function from its original level of performance before they become significant enough to affect the quality of radiographs. Tests should be conducted on a set schedule and should be arranged when the least amount of clinic disruption occurs. They should be conducted whenever changes have been made, such as equipment repairs in an x-ray room or chemical changes in a processor (if film is in use) or when a problem has been detected.

Some Quality Assurance tests can be done in-clinic by the Quality Control Officer but it’s important to note that a portion of the Quality Control tests (described below) will require an outside consultant and specialized equipment to perform these tests accurately, as part of servicing of a radiation unit.

ABVMA has produced Quality Assurance Videos to help veterinary practices. The videos are found on the Member Portal Practice Resources/Radiation Program/QA Video Series.

A general radiation safety video is available to assist in training new employees who help technologists with diagnostic imaging.

Each veterinary practice with radiation equipment must have a documented Quality Control Program in place that indicates which tests are performed, their frequency and the person responsible for the testing (staff or outside radiation service company). It is necessary to demonstrate that adequate testing be done to verify the objectives of testing procedures are met.

The quality control program will also document any steps taken to ensure correction, calibration or replacement that are required.

For additional information, also refer to the QC protocol described in the operating manual of your digital imaging unit. Also, Safety Code 35 has extensive information on Quality Control testing for various diagnostic imaging equipment.

1. Tests performed by the VPE Quality Control Officer **Annual**

The following tests must be done annually.

The ABVMA Radiation Program Quality Assurance Video Series, new in December 2022, is available on the Member Portal at Practice Resources/Radiation Program. The videos demonstrate how to perform the tests listed below.

a. Collimator Function Ensure the Collimator is functioning properly (Does not require specialized tools and can be performed in-clinic by the Quality Control Officer):

Collimator Alignment test (Coin test)
Objective: Verify the coincidence of the x-ray field and the light field. Improper alignment of the light field and the x-ray field will cause parts of the region of interest to be cut-off and may result in a non-diagnostic radiograph.

Minimum Collimation test
Objective: Ensure the minimum light field can be reduced to 2”x2” (or 5cm x 5 cm) at the distance of 40” or 100cm

Stepless Adjustment of field Size test
Objective: Ensure the light field size can be made smaller or larger by turning the collimator knobs without any difficulties or obstructions. The test is essential as it ensures the collimator leaves are not being obstructed by any internal components.

Collimator Light Visibility test
Objective: Ensure the collimator light is clearly visible even with the radiology room lights fully on. The Plexiglas covering the collimator light can become stained or burnt with age or the light bulb wattage needs to be adjusted. The exact bulb that is specified for each collimator must be used.

Perpendicularity of Light Beam at 90 Degrees to Tabletop test
Objective: Ensure the tube head is not rotated and the x-ray beam is perpendicular to the x-ray table. Rotation of the collimator or the tube head can distort the image.

Source Image Distance is Accurate to 2% test
Objective: Ensure the distance between the source of the x-ray beam (also known as the focal spot) to the receptor is accurately represented on the tube stand.

Collimator Indicator Accuracy test
Objective: Ensure the collimator indicators are accurate and coincide with the x-ray field for both the horizontal and vertical measurements.

Tube, Table and Tube Stand Stability test
Objective: Ensure the stability of the x-ray tube, stand and table as well as ensure none of the components move during an exposure.

Angulation Indicator is Correct test (no video)
Objective: Ensure the angulation indicator is accurate – Note that this test is only used for X-ray units with an angulation feature.

Dental Arm and Tube Head Stability (specific to dental intra-oral units)
Objective: Ensure the dental arm is not angled and the tube head stays in place during x-ray procedures.

b. Ensure Worker Protection Equipment is Functional
(Does not require specialized tools and can be performed in-clinic by the Quality Control Officer):

The objective of these tests is to ensure the protective clothing has no cracks or breeches that would reduce protection. Before starting the tests, ensure each piece of protective clothing is uniquely identified for documentation of the test results.

The ABVMA Radiation Program Quality Assurance Video Series, new in December 2022, is available on the Member Portal at Practice Resources/Radiation Program. The videos include:
Introduction to PPE Testing
Annual Testing of Protective Lead Aprons
Annual Testing of Protective Lead Thyroid Shields
Annual Testing of Protective Lead Gloves

Aprons and Thyroid Protectors:
Storage: Aprons should never be folded. Use a round object to store them on or place flat on the x-ray table.

Evaluation: Take images of personal protective clothing annually to look for any breaks in the protective lead lining. Include all of the front parts of the apron. Use settings that would be used for a kitten paw and always include the edges of the apron and thyroid shield looking for the stitching on the sides of the apron – these holes are an indication a "damage" in the lead is seen on the radiograph and settings are good. If the stitching on the sides of the apron is not visible, then the setting needs to be lowered. This area will show up as a line of black dots. If there are any cracks or faults in the apron, these will show up as dark lines or holes.

Gloves:
Storage: Gloves should be placed on something so air can circulate inside.

Gloves are difficult to radiograph for cracks as they are double layered, and one side will mask the other. Performing a manual examination of the gloves for cracks, splits, animal bite punctures, visible or physical damage will yield better results than imaging the gloves.
Dental x-ray plate can be used to test suspected damaged areas of the gloves. By placing the x-ray plate inside the glove in the suspected damaged area and radiographing the plate with the dental x-ray system. A damage/crack will appear dark in colour on the image.
The life expectancy of lead PPE is now recommended for 5 years, with proper storage.

Monthly

c. Detailed clean and inspection of all image receptors (CR and DR)

Remove the image plates (IPs) from each cassette and clean them according to manufacturer's specifications. Generally, a lint-free cloth (photographic lens cloth) or a camel hairbrush should be used to gently wipe any loose debris from the image plate. Most manufacturers have a special cleaning solution that can be used for IPs that have any dirt that is more difficult to remove. IPs that can no longer be cleaned effectively should be replaced. Because the photostimulable phosphors (PSP) material contains some barium, they cannot be disposed of in the standard trash and must be disposed of according to Environmental Protection Agency regulations. A licensed disposal company should be contacted to properly dispose of the IPs and the paperwork kept on file.

Clean and inspect DR cassettes. For DR image receptors that are contained in a bucky or chest unit, inspect the top surface of the active-matrix array (AMA) for dirt and scratches. Also, inspect any visible cables leading to the DR image receptor for any cracks in the insulation or plastic connectors or any exposed or bare wires. A thorough cleaning of the DR image receptor should be performed by a qualified service technician and scheduled accordingly.

d. Monthly Testing of Monitor Displays

All display devices used to view diagnostic images must be tested monthly. Many digital systems will provide recommended test patterns that can be used for visual testing, either as a digital function or a link in the manual.

For systems that do not offer built-in pattern or software, several patterns are recommended to visually confirm the performance of the display screen.

Pattern Test

The tests are performed by visually examining the test pattern displayed on the screen and confirming that all individual shades and lines can be discerned by the person(s) responsible for reviewing the images. SMPTE or TG18-QC test patterns can be used.

Defective Pixel Tests

The screen is set to display all white or all black screens. Defective pixels will often show up contrasting with the screen. The test will also help detect any physical dirt and debris on the computer screen.

Uniformity and Gradient Tests

By displaying a uniform grayscale page, it can be possible to detect unequal distribution of light on the screen. Similarly, gradient test can be used to show any abrupt changes in color display that need to be corrected.

Online Tests

The following test, provided by EIZO, a manufacturer of display products, covers the tests described above: www.eizo.be/mintor-test/

Service log review
Service logs of digital equipment should be reviewed to see if a specific problem is reoccurring. If so, possible solutions should be explored to minimize down time.

Monthly Repeat Reject Analysis (RRA)

The ABVMA Radiation Program Quality Assurance Video Series, new in December 2022, is available on the Member Portal at Practice Resources/Radiation Program, and includes a video Repeat/Reject Analysis.

Repeat analysis is an essential aspect of a quality control program. It is an organized process of categorizing rejected images and finding out the nature of the repeated images to minimize or eliminate them in the future.

A rejected image is defined as a radiograph that is deemed unacceptable in terms of image quality, by the radiographer at the time of acquisition.

A repeat image is any radiographic image that must be performed more than once because of human or mechanical error during the initial image.

All reject exposures must be documented to determine the cause of rejection. In this way you will be able to determine if most rejections are for positioning, density, motion, artifacts or miscellaneous causes. This will assist in the correction of these problems. The correction may require a change to the technique charts, equipment servicing, training of staff or more care in patient positioning.

The Repeat Reject Analysis review should be done whenever it is perceived that there is inconsistency of results (remember, a technique chart may help greatly) or minimally, every month. This allows corrections in technique before an inordinate number of unnecessary exposures occur and workers have been unnecessarily exposed to greater radiation dosage. The sample Repeat Reject Analysis (RRA) Form in Appendix 2 (also available as a stand alone form on Member Portal/Practice Resources/Radiation Program/sample Repeat Analysis Form) will assist you in documenting your rejects.

Objective:
Set up repeat analysis program.
Reduce the number of exposures required.

Repeat Analysis Program results should be used to inform all radiation workers of potential problems and to guide improvement in procedures.

Look At:
Total number of exposures as compared to the actual number of diagnostic quality images used or retained

Procedure for each radiation unit:
Determine the actual number of exposures

Determine the actual number of images used

Calculate the difference (i.e., repeat number)

Record this data in a Repeat Log, including reason

Determine the overall repeat rate.

e.g. *153 rejected images and a total of 1225 exposures*

$$\frac{153}{1225} \times 100\% = 12.5\%$$

Rejects from each category

e.g. *49 images too dark and there are 153 rejects*

$$\frac{\text{x}}{153} \times 100\% = 32\%$$

Acceptance Limits:
Overall repeat rate should be less than 10% and ideally 5% incidence which is the maximum recommended by the World Health Organization Any practice with repeat rates exceeding 10% to 12% should review their operating protocol closely.

The repeat analysis must be done on a monthly basis on each unit or whenever a problem is suspected.

Weekly

Clean monitor screens

Clean monitors according to the manufacturer's guidelines. Monitors attract dirt and dust due to electrostatic attraction. In addition, many monitors utilize touch-screen technology, which can cause dirt to build up quickly.

Care must be taken in cleaning LCD screens, as it is easy to damage the plastic face and the LCD crystals underneath the face. Closely follow manufacturer's guidelines.

Quick clean and inspect all image receptors

Clean and inspect all CR cassettes. Use a dry cloth or a cleaning solution specified by the manufacturer that is not water based. Assure bar code labels are clean and that hinges and latches are in good condition. Make sure that the IRD removes the imaging plates smoothly and easily, as well as reads and replaces in the cassette properly.

For DR image receptors that are contained in a bucky or chest unit, inspect the top surface of the active-matrix array (AMA) for dirt and scratches. Also, inspect any visible cables leading to the DR image receptor for any cracks in the insulation or plastic connectors or any exposed or bare wires.

Clean air intake ports on IRD (CR) and CPU (CR &DR)

This will prevent damage to the IRD and minimize artifacts that may be caused by dirt on the reader mirrors or on the lens of the scanning laser.

Clean computer keyboard and mouse

Clean the computer keyboard and mouse according to the manufacturer's guidelines. This will prolong the life of the computer components and also reduce the transmission of illness among staff.

Daily

l. Inspection of cassettes and viewing monitors

Inspect cassettes for cleanliness. Surfaces should be free of dirt and debris to avoid image artifacts or processing problems in the image reader device (IRD).

m. Erasure thoroughness (CR)

Erase all CR image plates before use according to manufacturer's directions.

n. Daily Monitor testing

It is a good general practice to test the viewing monitor daily at the beginning of each day. Check with the manufacturer for specific recommendations.

o. Workstation communication with IRD (CR and DR)

CR

Verify communication between the CR reader and workstations.
Make sure the bar code readers are working properly.

DR

Make sure that image data is transmitted from the cassette to the central processing unit of the imaging system.
Loose cables or a dead battery (wireless) can cause a lack of connection, as can interference in a wireless network.

Quarterly

p. Dosimeters must be submitted to your dosimeter service quarterly.

Dosimeter badges must be stored nearby the x-ray room, but not in the x-ray room as they may register scatter radiation that occurred during x-ray exposures and not reflect actual exposure to the individual who is supposed to be wearing the dosimeter.

Tests performed by a Radiation Service Company
Every 12 to 24 months, depending on volume of usage

Every 12 - 24 Months

X-Ray Generator Function Testing (Performed by Radiation Service Company)

- Kilovoltage test
  Ensures the KV value is true for each mA setting and within 8% of the allowable drift.
- Half-Value Layer test

The HVL indicates the thickness (in mm) of the (absorber material) aluminum within the generator that is required to reduce the x-ray beam to half of its original intensity. The HVL test ensures the intensity is reduced to 50%.

- mA Linearity test
  Measures the mA output from each station to ensure consistency and ensure it is within the 10% legal variable.
- Timer test
  The timer in the generator controls the length of time the radiation is produced. The test ensures the timer is consistent.
- Reproducibility test
  Tests the generator's ability to produce the same output at the same settings throughout several exposures.

The ABVMA Radiation Program Quality Assurance Video Series, new in December 2022, is available on the Member Portal at Practice Resources/Radiation Program and includes an informational video on generator testing.

DIGITAL RADIOGRAPHY QUALITY CONTROL PROGRAM VPE Radiation Quality Control Officer: Date:														
Test	**Frequency**	**Tracking**												
1. Inspection of cassettes and image receptors (CR and DR)	Daily	See separate tracking sheet												
2. Erasure thoroughness (CR)	Daily	See separate tracking sheet												
3. Workstation communication with IRD (CR or DR)	Daily	See separate tracking sheet												
4. Monitor testing	Daily	See separate tracking sheet												
5. Clean monitor screens	Weekly	See separate tracking sheet												
6. Clean air intake ports on IRD (CR) and CPU (CR and DR)	Weekly	See separate tracking sheet												
7. Clean computer keyboard and mouse (CR and DR)	Weekly	See separate tracking sheet												
8. Detailed clean and inspect all image receptors (CR and DR)	Monthly	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
9. Assess viewing monitor performance	Monthly													
10. Perform repeat analysis (CR and DR) on each x-ray unit	Monthly													
11. Service log review (CR and DR)	Monthly													
12. Dosimeters to Dosimeter Service	Quarterly													
13. Collimator Alignment Test (coin test)	Annual													
14. Minimum Collimation Test	Annual													

15. Stepless Adjustment of Field of Size Test	Annual	
16. Collimator Light Visibility test	Annual	
17. Perpendicularity of light beam at 90 degrees to tabletop	Annual	
18. Source Image Distance Accuracy	Annual	
19. Collimator Indicators Accuracy	Annual	
20. Tube, Table and Stand Stability Test	Annual	
21. Angulation Indicator is Correct Test	Annual	
22. Lead Apron test	Annual	
23. Thyroid Shield test	Annual	
24. Leaded Glove test	Annual	
25. Other: Lead Goggles, Leaded Face Shield, Lead Caps	Annual	

5. Laser safety and quality control

Lasers = Light Amplification by Stimulated Emission of Radiation

Class 3b and Class 4 – These classifications indicate that the laser radiation emitted from these devices is a hazard to unprotected eyes and/or skin from exposure to the direct beam and that exposure to the reflected or scattered beam may also be hazardous under some conditions. The direct beam may also be a fire hazard if it strikes combustible materials. Even a brief exposure can damage the retina and surrounding tissues. These eye injuries may interfere with vision either temporarily or permanently, in one or both eyes. It is therefore extremely important that all authorized personnel entering the area of operation of the laser be provided with and wear appropriate protective eyewear.

** Protective eyewear is the single most important piece of protective equipment needed by persons within the treatment area.

Skin damage can occur to unprotected/covered skin. The damage may appear like a severe sunburn. Reflected laser energy can be protected against by using diffuse reflective materials and instruments with low reflectance in or near the beam path. The primary hazard associated with lasers stems from inadvertent exposure to laser emissions. Exposure to an individual may occur directly from the laser beam, or when the beam is reflected from a shiny surface such as a mirror, ring, glass picture frame etc., or in the case of the CO2 laser from metal instruments and other common operative items. As previously stated, the eyes and skin are at greatest risk. Persons at greatest risk are mainly the staff carrying out laser procedures.

Lasers must be treated the same as x-ray equipment in regard to the hazards for veterinarians, technologists and staff directly involved with this type of equipment. Proper safety procedures must be in place and strictly followed to ensure safe use. It is best practice for the laser treatment area to be in a separate fully enclosed space with a closable door and covered windows. Appropriate laser warning signs must be posted at all entrances to the area only during laser treatments

As with all x-ray equipment, lasers must also be registered and certified with the ABVMA. The equipment must also be inspected prior to certification through an Authorized Radiation Protection Inspection Agency. The Agency will verify that the equipment and laser treatment area complies with the following checklist (See Laser Safety Checklist below). This ARPIA inspection of VPE laser(s) must be completed in person by the ARPIA.

It is the responsibility of the owner to ensure compliance with all of the requirements at all times. Each Veterinary Practice Entity must have a designated Laser Safety Officer appointed who is responsible for the implementation of the Laser Safety program as outlined in the following table.

5.1 Example Laser Safety Checklist:

Room

- Warning signs are posted during laser treatments. Window and door covers must be made of non-transparent, non-reflecting materials and best practice is that the material is labelled with laser stopping characteristics. The only exception is CO2 which is blocked by glass
- Fire extinguishers are available
- Storage for gas tanks
- Secure locked designated place for the laser key where applicable. Some lasers use and access a code, this code should be restricted to trained veterinarians and veterinary technologists.
- Designated place for accessories

Personal Protection

- Documented personal protection program
- Training for use and maintenance of personal protective equipment
- Laser glasses with damaged lenses must not be used

Laser Equipment

- Electrical outlets
- Electrical power cords
- Cooling water pressure
- Cooling water temperature
- Maintenance up-to-date
- Laser log up-to-date

Smoke Evacuator

- Filter change date record
- Responsibility for filter change assigned
- Valid safety sticker

Laser Operation

- Documented authorization procedure
- Written operating procedures
- Emergency contact telephone numbers of persons responsible for laser safety

Laser Safety Information Websites

Canadian Centre for Occupational Health and Safety – Lasers – Health Care
www.ccohs.ca/oshanswers/phys_agents/lasers.html

CSA Z-386-14 “Safe Use of Lasers in Health Care” is available from the Canadian Standards Association (rescinded in 2019 and under redevelopment)
Website: http://shop.csa.ca/en/canada/page/home

ANSI Z136.1 2014 Safe Use of Lasers
https://www.lia.org/resources/laser-safety-information/laser-safety-standards/ansi-_z136-standards/z136-3

5.2 Laser Safety Program

A Laser Safety Program Sample Template is provided to assist VPEs in documenting their Laser safety program, including standard operating procedures. Found (after login) on Member Portal/Radiation Program.

PIPS Bylaw SC-9 Lasers, page 70, #5:

A Laser Safety Program is in place and includes:

a. Delegation of authority and responsibility for the supervision of evaluation and control of laser hazards to an LSO.

b. Criteria and authorization procedures for all VPE professionals entering and or working within the NHZ.

c. Application of protective measures for the control of laser hazards.

d. Management and reporting of accidents or occurrences and preparation of action plans to prevent recurrence of an accident or incident.

e. Education and training of authorized personnel in the assessment and control of laser hazards.

f. Safety training is documented and provided to all VPE staff involved with the use of the laser.

Out of Service Radiation Equipment

All out of service radiation equipment must be stored in a manner to protect it from unauthorised or unintentional use.

Disposal of radiation equipment is guided by Section 6 of Safety Code 35.

VPEs must submit a Radiation Equipment Registration form or contact the ABVMA to cancel the registration certificate and remove the unit from the VPE's active radiation equipment list.

Safety Code 35 Safety Procedures for the Installation, Use and Control of X-ray Equipment in Large Medical Radiological Facilities

Disposal of X-ray Equipment

When X-ray equipment is considered for disposal, an assessment should be made as to whether the equipment can be refurbished and/or recycled. Communication with the manufacturer or supplier of the equipment should be made as to whether the equipment or components of the equipment can be recycled or returned.

Once the decision has been made to dispose of X-ray equipment, an assessment must be made to determine if any equipment components contain hazardous materials. For example, the X-ray tube may contain polychlorinated biphenyls (PCBs) and lead may be present in the X-ray tube housing. To ensure equipment is not unsafely operated after disposal, it should be made inoperable before disposing. The cables that power the equipment and other electrical connections should be disconnected and removed.

Generally, when disposing of an x-ray unit, most of it is scrap metal, but the transformer has oil in it and needs to be disposed of safely. It also needs to be tested for PCBs and then the oil drained and have a recycling company pick up the oil and dispose of it.

For disposal of class 3b and 4 lasers, follow the manufacturer's directions.

APPENDIX 1

Authorised Radiation Protection Agency Compliance Verification Checklist for Veterinary X-ray Equipment
In accordance with Safety Code 28, (1991), *"Radiation Protection in Veterinary Medicine"* Published by Health Canada

Item No.	Compliance Item Description	Safety Code Section
Responsibility and Personnel		**3**
1.	Responsible User: Registered Veterinarian or Registered Veterinary Technologist -Ensure that equipment is maintained and functions correctly -Ensure that maintenance is performed by competent personnel -Ensure that equipment is used correctly and only by competent personnel -Establish safe operating procedures and staff training -Carry out routine checks of equipment and facility safety features -Keep records of radiation surveys -Maintain personnel monitoring program -Investigate overexposures and implement corrective measures -Ensure that appropriate warning signs are properly located	3.2
2.	Equipment Operator: -Adequately trained -Aware of radiation hazards -Wear personnel monitoring devices	3.3
3.	Students or Operators-in-Training: -Work only under the direct supervision of a qualified operator -Dose limits are not greater than the limits set for members of the public	3.4
Equipment Specifications		**6.1**
4.	An X-ray control panel that is equipped with: 1. Warning Signs: A permanent and conspicuous sign prohibiting unauthorized use and warning that hazardous X-radiation is emitted when the equipment is in operation. 2. Markings: Controls, meters, lights and other indicators relevant to the operation of the equipment that is readily discernible and clearly labelled as to function. 3. Irradiation Light: A readily discernible separate indicator on the control panel that indicates when x-rays are being produced.	6.1.1 6.1.2 6.1.3
5.	Mechanical Stability: The X-ray tube ***must*** be securely fixed and correctly aligned within the x-ray tube housing. The X-ray source assembly ***must*** maintain its required position without excessive drift or vibration during operation.	6.1.4
6.	Irradiation Control: 1. There ***must*** be an irradiation switch, timer or other device to initiate and terminate X-ray production 2. This control ***must*** automatically terminate the irradiation after a pre-set time, product of tube current and time, or irradiation value has been reached. 3. Where an irradiation switch is provided, it ***must*** require continuous pressure by the operator to produce X- rays. 4. A foot switch is to be constructed so that no X-ray can be produced if it is inadvertently overturned. 5. The irradiation timer ***must*** be an electronic type: mechanical timers must not be used.	6.1.5
7.	Indication of Loading Factors: 1. For X-ray equipment having adjustable loading factors, the control panel ***must*** incorporate indicators that allow these loading factors to be determined. 2. For equipment having non-adjustable loading factors, permanent	6.1.6

	marks or labels may be used to indicate these parameters.	
8.	Timer Accuracy: The irradiation timer **should** be such that at each setting it is accurate to 1/60 second or 7% of that setting, whichever is greater.	6.1.7
9.	X-Ray Tube Voltage Accuracy: The generator **should** be such that at each setting it is accurate to 5% of that setting.	6.1.8
10.	Irradiation Reproducibility: For any selected combination of X-ray tube voltage, current and time greater than 1/10 second, the coefficient of variation of any 10 consecutive irradiations taken at the same distance within a period of 1 hour **should** not exceed 0.1.	6.1.9
11.	X- Ray Tube Shielding: 1. The X-ray tube ***must*** be enclosed in a shielded housing. The leakage radiation from the X-ray tube housing ***must*** not exceed 0.873 mGy (100mR) in 1 hour at 1 metre at the nominal X-ray tube voltage on the equipment.	6.1.10
12.	Beam Limiting Device: 1. The X-ray tube housing ***must*** be equipped with a beam-limiting device that enables adjustment of the size of the X-ray field. 2. The beam-limiting device **should** incorporate means to indicate the size of the X-ray field at the image reception area.	6.1.11
13.	Half-Value Layer: For a given Kilovoltage, the measured value of half-value layer of the useful beam ***must*** follow the limits below: 1. For equipment designed to operate with X-ray tube potentials below 70 Kilovolts, the half-value layer ***must*** not be less than 1.5 millimetre of aluminium (mm Al). 2. For equipment designed to operate with X-ray tube potentials at and above 70 kilovolts peak the half-value layer ***must*** not be less than: 2.1mm Al at 70 Kvp 2.3 mm Al at 80 Kvp 2.5 mm Al at 90 Kvp 2.7 mm Al at 100 Kvp 3.0 mm Al at 110 Kvp 3.2 mm Al at 120 Kvp 3.5 mm Al at 130 Kvp 3.8 mm Al at 140 Kvp 4.1 mm Al at 150 Kvp	6.1.12
Protective Clothing		**6.2**
14.	1. Protective aprons, gloves and thyroid shields ***must*** provide attenuation equivalent to at least 0.5mm of lead at X-ray tube voltages of up to 150 Kvp. 2. The lead equivalent thickness of the material used ***must*** be permanently and legibly marked on the protective device. Protection ***must*** be provided throughout the glove, including fingers and wrist. 3. Protective aprons, gloves and thyroid shields ***must*** be stored and maintained according to manufacturers' recommendations. 4. Protective aprons, gloves and thyroid shields ***must*** be checked by radiographing them annually or when damage is suspected.	6.2
Darkroom and Film Processing (if in use)		**6.3**
15.	The darkroom ***must*** be impervious to light.	6.3.1

16.	A warning light or sign **should** be located outside the darkroom to indicate when the room is in use.	6.3.2
17.	Safelights, fitted with light bulbs of correct intensity and filters appropriate to the specifications of the film used *must* be provided above the work area within the darkroom.	6.3.3
18.	Manufacturers' recommendations about the strengths and temperatures of the solutions and immersion times ***must*** be followed to ensure optimum film processing.	6.3.4
19.	Manufacturers' recommendations about the operation and servicing of automatic film processors ***must*** be followed to ensure optimum film processing.	6.3.5
20.	Developing solutions **should** be replenished and changed according to the manufacturers' recommendations.	6.3.6
21.	Unexposed radiographic films ***must*** be stored in such a manner that they are shielded from stray radiation. Storage **should** be provided such that no film can be exposed to more than 1.75 uGy (0.2mR) of stray radiation before use.	6.3.7
22.	Films **should** be stored on end in a cool, dry area.	6.3.8
Radiation Protection		**4**
23.	Adequate Shielding: 1. 20 mSv for radiation workers 2. 1 mSv for members of the public.	4.1
24.	The radiation beam ***must*** always be directed toward adequately shielded or unoccupied areas.	4.2.1
25.	The radiation beam and scattered radiation **should** be attenuated as closely as possible to the source.	4.2.2
26.	The shielding **should** be constructed to form an unbroken barrier. Lead must be adequately supported to prevent "creeping".	4.2.4
27.	A control booth ***must*** be provided for the protection of the operator (when necessary). The control booth should be positioned so that during an irradiation no one can enter the radiographic room without the knowledge of the operator.	4.2.5 &4.2.6
28.	Warning signs ***must*** be posted on all entrance doors of the radiographic room. The warning signs ***must*** incorporate the X-radiation warning symbol and **should** incorporate the words "Unauthorized Entry Prohibited".	4.2.8
29.	Mobile X-ray equipment used routinely in one location is considered to be a fixed installation, and the facility **should** be shielded accordingly.	4.2.9
30.	Radiation Protection Survey completed.	5.2
31.	All personnel ***must*** fully use all protective devices available.	7.1.5
32.	The X-ray tube housing ***must*** never be held by hand or supported by a part of the body during operation.	7.1.6
33.	If necessary, the animal **should** be sedated or holding devices used during radiography. However, if this is not possible and a person ***must*** restrain the animal, protective aprons and gloves ***must*** be worn and irradiation by the x-ray beam must be avoided. Individuals **should** avoid performing these duties regularly.	7.1.9
34.	A radiographic cassette holder ***must always*** be used. The radiographic cassette ***must*** never by held by hand.	7.1.10
35.	All operations of X-ray equipment, together with personnel who routinely participate in radiological procedures must wear personal dosimeters. When a protective apron is worn the personal dosimeter must be worn underneath. If extremities are likely to be exposed to higher doses; additional monitors **should** be worn on the extremities.	7.1.11 & 7.1.12
36.	For tabletop radiography when the sides of the table are not shielded, a sheet of lead at least 1 mm in thickness and slightly larger than the maximum beam size **should** be placed immediately beneath the cassette or	7.1.15

	film.	
37.	The fastest combination of films and intensifying screens consistent with diagnostically acceptable results and within the capability of the equipment **should** be used.	7.1.16

Authorised Radiation Protection Agency Compliance Verification Checklist for Class 3b and 4 Lasers

In accordance with **CAN/CSA-Z386-14 "Safe Use of Lasers in Health Care"**

Published by the Canadian Standards Association

Item No.	Compliance Item Description	Std Section	Yes	No	N/A
Risk Assessment - Hazards, Risks and Control Measures					
1	The nominal ocular hazard area has been determined for each laser in use.	4.0			
2	Policies, procedure and control measures are based on risk assessments of laser operations.	5.1			
3	Persons shall be protected through the implementation of appropriate control measures.	5.2.3			
Ocular & Skin Control Measures					
4	The required optical density of protective eyewear has been determined.	5.3.1.3			
5	Protective eyewear is available at each point of access to laser treatment controlled area.	5.3.1.3			
6	Protective eyewear is labelled with the optical density and wavelength it protects against.	5.3.1.3			
7	Protective eyewear is worn by all personnel in the laser treatment controlled area.	5.3.1.3			
8	Protective eyewear is maintained according to manufacturer guidelines.	5.3.1.3			
9	Protective eyewear has side guards on it.	5.3.1.3			
10	Protective eyewear is inspected prior to each use.	5.3.1.3			
11	Optical viewing equipment is equipped with filters that protect eyes from laser light.	5.3.1.3			
12	Patients are provided with eye protection from laser light.	5.3.1.3			
Fire and Explosion Control Measures					
13	Fire drills are conducted once a year.	5.3.3.3			
14	Fire extinguishers are located in areas free of physical obstructions.	5.3.3.3			
15	Laser personnel know how to access and operate the fire extinguishers.	5.3.3.3			
16	Laser delivery systems are tested prior to using lasers.	5.3.3.3			
17	The laser beam and delivering system is continuously monitored during operations.	5.3.3.3			
18	Water or saline is accessible in the laser treatment-controlled area.	5.3.3.3			
19	Wet cloths and drapes are on hand to protect non-targeted areas.	5.3.3.3			
20	Patient body cavity gases are evacuated.	5.3.3.3			
21	Only non-flammable / non-reflective material is used in the path of the laser beam.	5.3.3.3			
22	Electrical hazards are minimized by inspecting power cords and plugs prior to use.	5.3.3.3			
23.	Laser generated air contaminates are evacuated.	5.3.3.3			
Controls for Endotracheal Tube (ET) procedures					
24	A medical protocol for management of the patient airway during laser surgery is available.	5.3.3.4			
25	Persons are competent in-patient airway	5.3.3.4			

	management in the event of an airway fire.				
26	Laser-resistant endotracheal tubes are used.	5.3.3.4			
27	If the endotracheal tube is taped to the patient, non-flammable tape is used.	5.3.3.4			
28	Emergency patient airway management equipment is in the room prior to the surgery.	5.3.3.4			
29	A CO_2 laser is tested prior to the patient undergoing anesthesia.	5.3.3.4			
30	Clear communication is established during jet ventilation anesthesia procedures.	5.3.3.4			
31	The laser in not placed in the ready mode until a verbal order is given to hold ventilation.	5.3.3.4			
32	The patient's face, eyes and teeth are protected from the laser beam.	5.3.3.4			
33	Cotton patties to pack the ET tube cuff are included in the nurse's surgical sponge count.	5.3.3.4			
Infection Control Measures					
34	Standard / universal precautions are used when caring for patients.	5.4.1.3			
35	Bio-hazardous waste is properly disposed.	5.4.1.3			
36	Procedures are available for the draping of laser delivery systems.	5.4.1.3			
37	Procedures are available for cleaning and decontamination of laser equipment.	5.4.1.3			
Gases, Dyes, and Liquid Coolants Control Measures					
38	Material Safety Data Sheets are available.	5.4.2.3			
39	There is a policy for prevention of exposure to gases, dyes, and coolants.	5.4.2.3			
40	Persons exposed to gases/dyes/coolants are referred to a physician /laser safety committee.	5.4.2.3			
Purge Gas Control Measures					
41	Caution is exercised when using purge gas in a body cavity during laser surgery.	5.4.3			
42	Purge gas should be filtered.	5.4.3			
43	CO_2 is used as a purge gas instead of air or medical air whenever possible.	5.4.3			
Administrative Controls					
44	The facility administration shall ensure that a laser safety program is established.	7.1			
45	Policies and procedures shall be reviewed yearly and revised as necessary.	7.1			
46	Operations personnel are involved in the development /revision of laser safety procedures.	7.1			
47	Personnel have access to policies and procedures specific to each area of laser use.	7.2			
48	A Laser Utilization Record is kept of laser use.	7.2			
49	A laser safety checklist is used if it is not included in the Laser Utilization Record.	7.2			
50	Laser safety audits are conducted annually and reviewed by the laser safety officer.	7.2			
51	The laser safety officer has access to all reports on the lasers and related equipment.	7.2			
52	Incident reports are written for adverse laser events.	7.2			

53	The laser safety officer is immediately advised of all laser incidents or adverse laser events.	7.2			
54	The laser safety officer has access to laser safety committee minutes if applicable.	7.2			
55	The laser safety officer maintains lists and records of current authorized laser users.	7.2			
56	The laser safety officer keeps records of laser hazard analyses and risk assessments.	7.2			
57	Procedures /checklists are used to deal with the unscheduled shutdowns of lasers.	7.3			
Laser-Controlled Area					
58	The nominal ocular hazard area is restricted to the room in which the laser is operated.	8.1.4			
59	Access to the room where the laser is operated is controlled.	8.2.1			
60	Power to the laser will not be automatically turned off by opening the entrance door(s).	8.2.1			
61	The protective eyewear required when the laser is operating will be posted at the entrance.	8.2.1			
62	Preventive measures are taken to prevent the laser beam from passing through windows.	8.2.1			
63	The area where the laser is operated is properly supervised.	8.2.1			
64	When a laser is in use only persons approved by the laser safety officer are in the room.	8.2.1			
65	The laser area is free of surfaces that could cause hazardous reflections of the laser beam.	8.2.1-2			
66	Measures are taken to prevent the laser beam from contacting combustible material.	8.2.1			
67	Lasers emitting different wavelengths are not operated simultaneously.	8.2.1			
68	When the laser is not in use the laser control panel key is kept in a secure area.	8.2.1			
69	The nominal ocular hazard area is reassessed prior to laser repair, service, or maintenance.	8.2.1			
Heating, Ventilation, and Air Conditioning					
70	Heating, ventilation, and air conditioning (HVAC) systems comply with building codes.	8.3			
71	The air intake and outlet of the HVAC system is kept unobstructed at all times.	8.3			
72	The room is well-ventilated to help remove excess heat generated by the laser.	8.3			
Engineering Controls (Equipment)					
73	The laser control panel provides an indication of the power output of the laser.	8.4			
74	The laser control panel has a removable key or security code.	8.4			
75	The laser has a visual warning that is activated during laser emission.	8.4			
76	The laser system is affixed with warning labels at all openings where the beam is emitted.	8.4			
77	The foot pedal controlling laser emission has a guard on it to prevent inadvertent operation.	8.4			
78	The laser operating manual is readily available to personnel.	8.4			
79	The laser delivery device operating manual is readily available to personnel.	8.5			

80	Only manufacture approved laser delivery devices are used with the laser.	8.5			
81	Laser delivery devices are assembled / tested according to the manufacturer guidelines.	8.5			
82	Laser delivery devices are maintained / serviced according to the manufacturer guidelines.	8.5			
83	Laser optical components are cleaned and inspected according to manufacturer guidelines.	8.5			
84	Only the person handling the laser delivery device may activate the laser emission switch.	8.5			
85	The laser emission footswitch is never bagged, as this can cause inadvertent firing.	8.5			
86	Instruments used in the beam path or adjacent to the treatment site have a matte finish.	8.6			
Warning Signs					
87	Laser warning signs are posted at all points of access to the laser treatment-controlled area.	8.7.2			
88	Laser warning signs indicate the wavelength and hazard class of the laser being used.	8.7.2			
89	Laser warning signs are only visible when the laser system is powered on or in standby.	8.7.2			
90	Laser warning signs indicate that protective eyewear is required to be worn.	8.7.2			
91	Laser warning signs specify the nature of the hazard and the protective measures required.	8.7.7			
92	A temporary laser area warning sign is posted whenever the laser is being serviced.	8.7.8			
Patient Protection					
93	Patients are provided with information on risks of the laser and protective measures taken.	9.1			
94	A patient undergoing a laser procedure shall be fitted with eye protection.	9.3			
95	Patient's teeth in the operative field are protected from exposure to the laser beam.	9.2			
Laser Acquisition					
96	The facility has a documented process for the selection and acquisition of lasers.	10.1.1			
97	The facility prepares a clear statement of objectives on the use of the laser system.	10.1.2			
98	Policies, procedures, training, and safety guidelines are in place prior to laser use.	10.1.2			
99	The appropriateness of a room is reviewed prior to laser use in the room.	10.1.2			
100	Lasers are marked with the appropriate risk classification or equipment type.	10.1.3			
101	When a laser is used on a trial basis only persons with proper credentials may use the laser.	10.1.4			
102	Safety equipment should be available at the time the laser system is acquired.	10.1.6			
103	The laser room satisfies the *Canadian Electrical Code, Part I* and manufacturer guidelines.	10.3			
Laser Maintenance					
104	A maintenance program for the laser is in place.	10.4.2			
105	Laser inspections, tests, and maintenance require a written plan approved by the facility.	10.4.3			
106	All laser equipment malfunctions are recorded and corrected.	10.4.4			
107	Equipment service information is made available	10.4.5			

	to laser users.				
108	Preventive maintenance is conducted to verify correct operation of the laser system.	10.4.6			
109	Inspection /maintenance shall be conducted if the laser is suspected to be damaged.	10.4.7			
110	Control measures are in place to gain access to lasers that are normally enclosed.	10.4.8			
111	Laser service personnel are properly trained.	10.4.8			
112	Laser alignment procedures are used to prevent persons from exceeding exposure limits.	10.4.10			
Responsibilities, Education, Training and Credentials					
113	A laser safety officer has been appointed for the facility.	6.3.1.2			
114	The facility has a laser safety committee.	6.2.1.1 - 2			
115	The type of laser training provided has been properly evaluated.	6.2.2.4			
116	All persons involved in laser operations are trained in laser safety.	6.1			
117	A record of persons who have completed laser safety training is maintained.	6.2.2.5			
118	Only persons approved by the facility administration may use healthcare lasers.	6.3.2.2			
119	A list of personnel with laser use privileges is maintained.	6.3.1.4.2			
120	Responsibilities of persons in a laser-controlled area are clearly assigned and understood.	6.4.1.3			
121	Trainees are under the direct supervision and responsibility of authorized laser personnel.	6.4.3.1 - 3			

Appendix 2

Sample Repeat Analysis Form
This form is to be completed monthly for each unit

X-ray Unit: _____

Analysis Start Date: _____Analysis End Date: _____

TOTAL NUMBER OF EXPOSURES (including repeats) TAKEN for this month | |

Category	Number of exposures repeated this month
Equipment	
X-ray unit malfunction	
Software malfunction	
Other (specify)	
Patient	
Motion	
Unintended body part obscuring image	
Collar/foreign objects	
Other (specify)	
X-ray personnel error	
Positioning	
Incorrect markers	
Other (specify)	
Technique Chart/Settings	
Overexposed	
Underexposed	
TOTAL NUMBER OF REPEATED EXPOSURES	

Repeat Rate = Total Repeated Exposures x 100
Total Exposures Taken

Calculated Repeat Rate for the month =	**%**

The repeat analysis monthly percentage is **usually 5 – 10 %, ideally 5% incidence**. If the repeat rate is higher, evaluation of the causes is necessary in order to decrease unnecessary radiation to personnel and patients.

Each year as part of the VPE annual online Renewal, VPEs are required to report the number of patients x-rayed in the past year, the number of exposures taken and the total number of reject exposures.

Appendix 3
Service Category 8 and 9 from ABVMA Quality Assurance Self-Verification Guide

SC-8: Diagnostic Imaging Service Category Not Applicable			
f diagnostic imaging comes with a responsibility for patient care in the production of diagnostic vell as protection of the patient, workers and the public from potentially deleterious effects of exposure to radiation, magnetic fields, radio waves or other harmful substances, directly or indirectly. this standard is guided by: Alberta OHS Act and Code, *Health Canada Safety Code 28* and *Health Canada Safety Code 35* and the ABVMA Radiology Quality Assurance Program.			
	Radiation emitting imaging equipment is inspected and certified by an Authorized Radiation Protection Inspection Agency (ARPIA). The ABVMA certificate of registration for each radiation/laser unit is available to the PIPS Inspector.		
	Radiation emitting imaging equipment is registered with the ABVMA Radiation Protection Program. Annual Confirmation of Registration is in place.		
	The shielding of the designated radiation area is appropriate for the size and use of the room. The radiation area is free from related hazards to patients, clients and personnel.		
	Radiation warning signs are posted on all entrances to the designated radiation area.		
	Radiation Protective Equipment is available and in use, including: • Collimator • Protective apron x 2 • Protective gloves with cuff x 2 • Thyroid Protector x 2 • Personal dosimeters specific to the VPE, for each team member working with or near radiation equipment: Dosimeters are worn at a body location recommended by the dosimeter provider Dosimeters are sent in regularly for analysis		
	If applicable, radiographic screens and cassettes are free from defects.		
	A hard copy or computerized radiographic log for all radiographs (including dental radiographs) is maintained. The radiographic log includes the following: a. Owner/patient identification b. Exposure technique information (kVp, mAs, MA) (not required for automated digital systems) c. Body part thickness (where applicable) (not required for automated digital systems) d. Number of exposures, diagnostic and non-diagnostic e. Names of individual(s) who took the exposure and/ or restrained		
	A means to view diagnostic images (film illuminator and/or high-resolution digital image viewer) is easily accessible.		
	A documented Radiology Quality Assurance Program is in place, consistent with that outlined in the ABVMA's Radiation Protection Program Manual.		

	Registration of equipment is required when: a. Installation of equipment (new or used) in a new or existing VPE. b. Relocation of equipment within the VPE facility, or to another location. c. Modification of the characteristics of the radiation emitted from the equipment, or the protective properties of the equipment. d. CR and DR image receptors must be installed on X-ray systems which have an automatic means of controlling exposures, such as an automatic exposure control.		
	For digital systems, specific quality control testing must be performed on the image acquisition, storage, communication, and display systems.		
	All equipment-specific, manufacturer specified tests must be performed.		
	An individual in the practice (registered veterinarian or registered veterinary technologist) is identified as the Quality Control Officer whose duties include a. Assuring the radiation equipment is inspected by an Authorized Radiation Protection Inspection Agency every 5 years, or when relocated or modified. b. Ensuring that equipment is maintained and functions correctly. c. Ensuring that maintenance is performed by competent personnel. d. Ensuring that equipment is used correctly and only by competent personnel. e. Establishing safe operating procedures. f. Carrying out routine checks of equipment and quality control tests. g. Keeping records of radiation logs, quality control tests. h. Maintaining personnel monitoring program (Personal dosimeters). i. Monitoring the repeat reject analysis monthly, on all units, and implementing corrective measures. j. Ensuring that appropriate warning signs are properly located.		
	Diagnostic imaging is provided on premises at a VPE Facility or as part of an ambulatory practice.		
	All diagnostic images are permanently labeled with the date as well as the VPE name, either the patient file number or patient identification, and survey view marker		
	Diagnostic imaging equipment consistently produces images that are of diagnostic quality.		
	All diagnostic images (including but not limited to digital and hard copy radiographs, ultrasound, fluoroscopy, endoscopy, computed tomography, magnetic resonance imaging) are securely archived or filed in a manner which preserves their quality and allows for easy retrieval.		
	As an extension of the medical record, all diagnostic images are stored and maintained for the same length of time as the medical record.		
	If a patient is to be temporarily transferred or referred to another facility for diagnostic imaging, there must be documented, informed client consent (verbal or written) for this referral.		
	Attention must be given to ensure that the quality of diagnostic images is maintained, and that patient information is not lost or unintentionally altered.		
	Specific attention is paid to safety of clients and the public when providing radiation services through SC-2: Ambulatory Care.		

	There must be a means of sharing digital images that will enable others (receiving or referral practices, other colleagues, owners) to view the images without proprietary software		

SC-9: Lasers

Service Category Not Applicable

This standard applies to the use of all Class 3B and 4 lasers whether used for surgical or therapeutic purposes. Proper use of lasers is very important for the safety of the staff, patients and public. The laser beam can result in retinal or corneal damage as well as skin burns. *Damage to the retina is permanent.* Non laser beam hazards are equally important and are associated with either the laser equipment (e.g., electrical, fire hazards) or fumes emitted from the materials exposed called Laser Generated Airborne Contaminants (LGAC) or laser plumes. Laser plumes may contain carcinogens, irritants, viruses, cancer cells, bacterial spores, toxic gases or chemicals. Implementation of this standard is guided by the Government of *HS Regulation and Code,* CAN/CSA-Z386-08 "Safe Use of Lasers in Health Care Facilities", published by the Canadian Standards Association and *ABVMA: Radiation Protection Manual*, pages 30-35 "Compliance Verification Checklist for Class 3B and 4 Lasers". This standard applies to the use of all Class 3B and 4 lasers whether used for surgical or therapeutic purposes.

1.	Lasers used within the VPE must be registered with and certified by the ABVMA.		
2.	Lasers must be inspected by an Authorized Radiation Protection Inspection Agency (ARPIA) prior to certification and use.		
3.	Laser equipment requires documented calibration by a qualified person at a frequency established by the manufacturer.		
4.	Engineering Controls: • Guarded activation switch (foot pedal or finger trigger) • Accessory attachments (e.g., hand pieces, scopes and filters, fibers, remote controls, scanners, etc.) are compatible and safe • Equipment warning labels are visible during laser operation, not covered or removed		
5.	Administrative & Procedural Controls: a. Standard Operating Procedures - written & approved. b. Manufacturers' Procedures - approved, available and current. c. List of authorized laser users within the VPE. d. Key control is disabled (removal of key during prolonged periods of non-use). e. Use of diffuse or low reflective instruments and materials in or near the beam path. f. Laser safety audit completed and documented.		
6.	Protective equipment is used by all personnel within the Nominal Hazard Zone (NHZ).		
7.	Protective eyewear in use as specified by the manufacturer or the Laser Safety Officer (LSO) and is accompanied by the following information: a. Optical density and wavelength specified on the eyewear b. Manufacturer's recommendations on shelf life, storage conditions and appropriate cleaning methods		
8.	Protective eyewear shall have periodic cleaning and inspection for: a. Pitting, crazing, cracking, discoloration, etc. of attenuation material b. Mechanical integrity of the frame c. Worn or damaged straps or other retaining devices d. Light leaks and coating damage *Standard prescription glasses do not replace specific protective laser eyewear.*		
9.	Patient eye protection – suitable protective eye pads or corneal shields.		
10.	Appropriate skin protection -surgical gowns and gloves.		
11.	A Laser Safety Officer (LSO), registered veterinarian or registered veterinary technologist, is appointed who will: a. Assure that all lasers and laser systems have been properly classified and labeled to indicate the appropriate hazard classification. b. Ensure that a hazard evaluation of the laser treatment-controlled area has been performed prior to laser operation.		

	c. Immediately inform the user of imminent danger from a laser hazard. d. Ensure that control measures are in effect: and periodically evaluate the effectiveness of the selected controls. e. Establish and enforce standard operating procedures (SOPs). f. Ensure that protective equipment is available, in good working order and is used correctly. g. Ensure that the wording on area signs and equipment labels are accurate and appropriate. h. Conduct hazard evaluation of modifications to existing facilities or laser equipment. i. Ensure that maintenance and service is carried out by qualified personnel and such service is documented. j. Ensure that appropriate safety education and training is provided to all personnel associated with lasers. k. Provide safety instructions, which shall be incorporated into the standard operating procedure (SOP) for the laser.		
12.	In a non-hospital environment, the LSO shall: • Assume all administrative responsibilities for laser use. • Be trained in laser safety and have plainly written procedures for safe use. • Be responsible for: ○ The physical facility and its signs ○ Proper use of protective eyewear and other safety measures ○ Overseeing maintenance		
13.	A Laser Safety Program is in place and includes: a. Delegation of authority and responsibility for the supervision of evaluation and control of laser hazards to an LSO. b. Criteria and authorization procedures for all VPE professionals entering and or working within the NHZ. c. Application of protective measures for the control of laser hazards. d. Management and reporting of accidents or occurrences and preparation of action plans to prevent recurrence of an accident or incident. e. Education and training of authorized personnel in the assessment and control of laser hazards. f. Safety training is documented and provided to all VPE staff involved with the use of the laser.		
14.	Medical surveillance of VPE personnel: a. All laser incidents (accidents or adverse events) shall require an incident report and an ocular evaluation shall be carried out immediately after a suspected abnormal exposure of the eye.		

Appendix 4
Designated Radiation Equipment Registration Certificate

REGISTRATION CERTIFICATE FOR DESIGNATED RADIATION EQUIPMENT

The designated radiation equipment described below is registered under Alberta's Radiation Protection Program for the purposes of satisfying the registration certificate requirement under section 291.7 of the Occupational Health and Safety Code.

Carlos Smith Practice

1234-56st edmonton AB T6E 1A7

Registration No.	Equipment Description	Equipment Serial No.	Equipment Model No.	Equipment Manufacturer	Equipment Location
126429	Standard x-ray	AHF968-0521	InnoVet	Summit	X-ray

As per section 291.7 of the OHS Code, a copy of this certificate must be posted near the equipment, or if this is not practicable, its content communicated to affected workers.

Certificate No: 6429
Issue Date: 07/07/2021
Expiry Date: 07/02/2026

Darrell Dalton, DVM, Registrar - ABVMA
Authorized Radiation Health Registration Agency

Appendix 5
Application for registration of radiation and class3b/4 laser equipment form – Online VPE form

ABVMA
Alberta Veterinary Medical Association

ALBERTA VETERINARY MEDICAL ASSOCIATION
RADIATION PROTECTION ACT –APPLICATION FOR REGISTRATION EQUIPMENT

PERSONAL INFORMATION

First Name: Surname:

Facility:

REASON FOR APPLICATION

Owner: Facility: New

Equipment: Status: Pending

OWNER INFORMATION

Owner Name

Address:

Telephone: Fax:

FACILITY INFORMATION

Equipment Description

Equipment Type:

Is beam path fully enclosed?

Equipment Information:

Manufacturer Name:

Model Name: Serial Number: Location: Date of Manufacturer:

Signature: Date: