

Hospitals are required to have a radiation protective equipment inspection program.

Implementation of an X-ray Radiation Protective Equipment Inspection Program

René Michel and Michael J. Zorn*

Abstract: In order to comply with the requirements established by healthcare organization accrediting agencies, radiation protective equipment (e.g., lead aprons, gloves, and collars) utilized by x-ray workers must be periodically evaluated for damage. The objective of such evaluations is to identify and remove from service equipment bearing large holes, tears, etc., that could compromise the safety of individuals using this equipment. Many facilities are cited each year for failing to ensure the availability and integrity of such equipment. Unfortunately, written guidance on the proper implementation of inspection programs is not readily available. This paper was developed to assist healthcare organization safety personnel in establishing a radiation protective equipment inspection program at their facilities. *Health Phys.* 82(Supplement 1):S51-S53; 2002

Key words: operational topic; x-ray machines; radiation protection; medical radiation

INTRODUCTION

To reduce radiation exposures, x-ray workers are usually required to wear radiation protective equipment (RPE), most commonly protective lead aprons and collars (Fig. 1).

* VA San Diego Healthcare System, 3350 La Jolla Village Drive, San Diego, CA 92161. For correspondence or reprints contact R. Michel at the above address, or email at rene.michel@med.va.gov.



René Michel is a progressive and highly motivated radiation protection professional with over ten years experience in a national laboratory, industrial, university and hospital environments. He is the radiation safety officer at the VA San Diego Healthcare System, which operates the largest funded research program in the national VA system. Mr. Michel holds a MS degree in Radiological Health Physics from San Diego State University. He has published numerous papers on radiation safety program management. Besides being one of the editors of this journal he is also a regular contributor. His email address is rene.michel@med.va.gov.

Copyright © 2002 Health Physics Society

A typical lead apron or collar consists of lead-impregnated vinyl or rubber sheets finished with an outer layer of nylon fabric.

Besides being subjected to normal wear and tear, RPE is sometimes inadvertently damaged when not properly handled or stored. Lead aprons sometimes are folded or dropped on the floor in such a way as to cause sharp bends in the vinyl that deteriorate the lead-impregnated vinyl (Fig. 2).

This deterioration appears as cracks or holes in the shielding. Periodic RPE inspections are necessary since the health and safety of x-ray workers, as well as that of the patients, may depend on the integrity of this equipment.

APPLICABLE STANDARDS

Requirements for the evaluation of RPE are established in the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) Accreditation Manual for Hospitals (JCAHO 2001), which mandates that

healthcare organizations perform inspections of medical equipment, including RPE. This standard does not address specific requirements on the elements of the inspection plan. As a result, individual medical facilities have the flexibility to develop and implement their own policies. Besides ensuring that healthcare organizations have written policies and procedures in place, JCAHO representatives usually perform spot checks to verify the proper inspection and documentation of RPE.

DEVELOPING A POLICY

When developing a policy on RPE inventory and inspections, healthcare organizations should address a number of areas, including the following:

- Determine who is responsible for inventorying and inspecting equipment;
- Develop procedures to conduct inventories and inspections;
- Determine inspection frequencies; and
- Determine rejection criteria.

Ideally, each x-ray area should be supplied with sufficient RPE for patients and staff to meet policy requirements. The supplied equipment should be appropriate to the stated use and in appropriate sizes to fit all members of the staff.

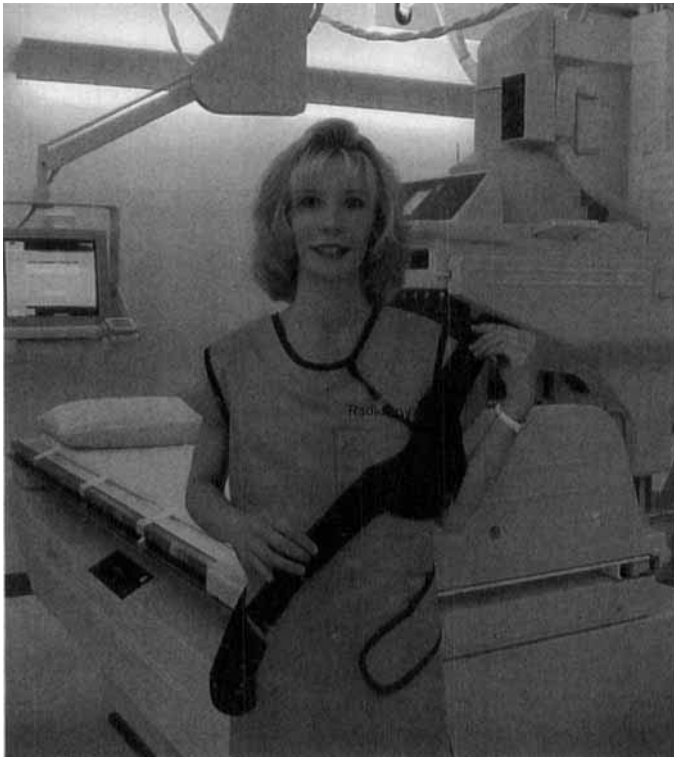


Figure 1. RPE helps reduce radiation exposure to x-ray workers.

DETERMINING RESPONSIBILITIES

Large institutions may designate a team, consisting of members of their Radiation Safety Office and Radiology Department, to share the responsibility of periodically inspecting RPE. Similarly, departments using x-ray equipment may designate contact persons responsible for coordinating (with the RPE inspection team) inspections within their areas and ensuring that new equipment is inventoried and inspected before use. X-ray workers

should be instructed to routinely inspect their RPE for defects (Fig. 3) and notify their department representatives if there is any indication that the effectiveness of such equipment may be compromised.

In turn, these department representatives should contact the RPE inspection team to ensure that such equipment is promptly evaluated. Usually the Radiation Safety Office retains all RPE inventory and evaluation records.



Figure 2. Folded RPE may be damaged in such a way as to cause sharp bends in the vinyl that deteriorate the lead-impregnated vinyl.



Figure 3. Routine RPE inspections help identify damage (e.g., tears, perforations, thinning, etc.) that compromise the effectiveness of this equipment.

PROCEDURES

RPE should be physically inspected regularly for defects and to ensure it is properly used and stored (Fig. 4).

Each piece of RPE should be individually marked with a unique identification number as well as the date when it is due for inspection (Fig. 5).

Healthcare organizations use different criteria to comply with the RPE inspection standards established by JCAHO. Some institutions examine their RPE for radiation penetration (radiographically or fluoroscopically). Other institutions, citing ergonomics concerns as well as unwarranted exposure to radiation (occupational doses received by the individuals examining RPE), elect to perform initial physical inspections to identify potential defects and examine for radiation penetration only equipment suspected to be defective.

The following is a typical procedure utilized to inspect RPE:

Sample procedure

1. RPE must be individually marked with a unique identification number as well as the date of the most recent inspection and the due date for the next inspection;

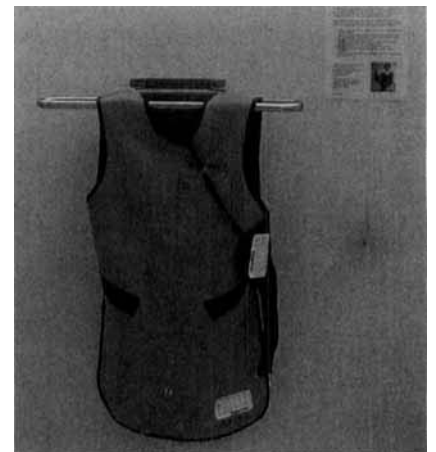


Figure 4. When not in use, lead aprons must be hung by both shoulders on a rack.

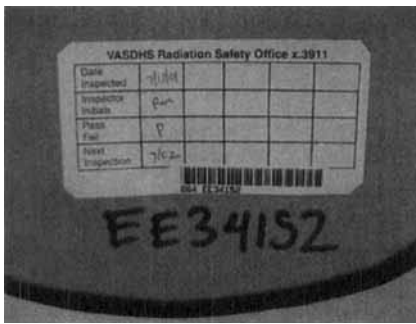


Figure 5. RPE should be individually marked with a unique identification number as well as the date when it is due for inspection.

2. All RPE must be physically examined for defects such as tears, perforations and thinning creases annually or upon request from staff;
3. All equipment, except glasses and movable barriers, that does not pass physical inspection must be temporarily removed from use and examined for radiation penetration;
4. Defective equipment must be immediately removed from use and repaired if possible. Such equipment must not return to service until it has been determined to be safe by a qualified individual (e.g., a health physicist or medical physicist); and
5. Any defective RPE that cannot be repaired should be properly disposed.

The following are special considerations to be followed for each type of RPE when performing radiation penetration exams (Table 1):

Table 1. Procedure to inspect RPE

RPE type:	Special considerations:
Aprons, gonad shields, thyroid shields	Fluoroscopically examine equipment at 80 KVP. This includes new equipment that has been in service less than a year.
Gloves	Radiologically examine equipment at 120 KVP, 2.5–3.2 MAS at 40 inches. This includes new equipment that has been in service less than a year.
Glasses and movable barriers	No radiation penetration tests required.

REJECTION CRITERIA

Until recently, there was little information available to determine when RPE should be rejected and removed from use. As a consequence, many facilities had established arbitrary rejection criteria. Lambert and McKeon (Lambert and McKeon 2001) established rejection criteria by calculating increases in doses to the whole body for varying sizes of holes, including special consideration of the effects on effective dose equivalent when the hole is over the testes and thyroid. These authors recommended that lead aprons be replaced if a defect is greater than 15 mm² unless the defect is clearly not over a critical organ. Lead aprons with defects along the seam, in overlapped areas, or on the back of the lead apron would be subject to the less conservative 670 mm² rejection criteria. Thyroid shields with defects greater than 11 mm² should be replaced.

RPE CARE

As mentioned at the beginning of this paper, RPE is sometimes inadvertently damaged when not properly handled or stored. Instructing RPE users on how to properly take care of this equipment can help in ensuring that RPE provides optimal protection and reducing the number of defective equipment that has to be repaired or discarded. The following simple care and inspection guidelines may be used to help in achieving this goal:

- Before use, inspect RPE for defects such as tears, perforations and thinning creases;
- When not in use, hang lead aprons by both shoulders on a rack;
- Keep RPE clean and free of dry blood and other fluids;
- Do not lay RPE over processor or any other source of heat;
- Do not puncture RPE with any sharp objects;
- Do not throw RPE on the floor or crinkle it in any way;
- Do not put the RPE through the laundry or clean it with chemicals; and
- Hand wash RPE with mild soap and water, rinse with a damp cloth and hang to air dry.

All RPE should be inspected at the prescribed frequency and/or upon request from users. Any equipment suspected to have a defect should be temporarily removed from use until proven safe by a qualified individual.

CONCLUSION

In order to comply with the requirements established by healthcare organization accrediting agencies and ensure personnel occupational exposures to radiation are kept as low as reasonably possible, safety staff as well as x-ray workers must periodically evaluate RPE for damage.

This paper provides basic information to assist healthcare organization safety personnel in establishing a radiation protective equipment inspection program at their facilities.

REFERENCES

- Joint Commission on Accreditation of Healthcare Organizations. Accreditation Manual for Hospitals, Environment of Care Section 1.6. Chicago: Joint Commission on Accreditation of Healthcare Organizations; 2001.
- Lambert KN, McKeon T. Inspection of lead aprons: Criteria for rejection. Health Phys (Supplement 1) Operational Radiat Safety 80:5:S67–S69: 2001.