protecX

Inspecting your Protective Aprons

Cleaning Guide & FAQ's

To maximize your lead apron life

- Hang your aprons correctly between use
- Wear aprons correctly, ensuring you wear the correct size
- Clean your aprons regularly
- To transport aprons, lie flat or roll
- Screen your aprons regularly
- Inventory management system to track apron damages

Determining apron viability

How do I know when an apron passes/fails inspection?

While there are no government guidelines in place to evaluate whether an apron passes or fails an inspection, there are some industry norms. **Please consult with your own Medical Physics/Radiation Safety Department for Local Authority Rules & Guidance.**

Many hospitals and research organizations use the widely cited article entitled "Inspection of Lead Aprons: A Practical Rejection Model" of Drs. Pillay and Stam (Health Physics, volume 95, No. 2, August 2008). This article gives criteria to aid in determining when lead aprons should be discarded, such as:

- **Tearing**
  For a single apron with a 0.50 lead/lead equivalency, tears of more than 5.4 cm in length are cause for rejection. Smaller perforations or cracks in the edges can result in rejection as well, depending on the length and width of the apron as compared to the size of the defect. Taking an x-ray/fluoroscopy image of the apron is often the only way to detect smaller breaks or cracks .
- **Thinning**
  Thinning of the lead and the outer protective layer of the apron also warrants rejection. Thinning is the result of prolonged use, and creates a floppy, comparatively lightweight apron that can expose the patient or health care worker to radiation. Thinning is determined by measuring thickness in relation to the size of the apron. The grayscale method is the easiest way to determine thinning.
- **Defects in relation to placement**
  Defects near certain organs would cause an apron to be rejected: 1.7 cm tear over the gonads, 1.8 cm tear over the thyroid, etc. These values are for a single apron comprised of .5 mm lead (or lead equivalent).
- **Defective Velcro, Buckles or Ties**
  Irreparably broken apron closures warrant an inspection failure. Each lead apron is designed to protect different areas of the body. Broken Velcro or other closure mechanisms will cause the unsecured apron to slide or part, exposing the organs to harmful x-rays, and is therefore not acceptable.

Rejection Criteria

Lambert and McKeon proposed that aprons be imaged, either with X-rays or fluoroscopy and the size of any defects measured. It was recommended that an apron be discarded if a defect of 15 mm2 or greater was detected. If the defect was clearly not over a critical organ, such as the gonads, then a less stringent 670 mm2 was recommended as grounds for removal. Not over a critical organ was defined as "along the seam, in overlapped areas, or on the back of the lead apron."

Table 2.3 Maximum tolerable tear length (mm) for an exposure of 100mSv. (12)

Rejection Criteria		Lead Equivalence (mmPb)		
		0.25	0,35	0,5
Type of Apron	Body Area	Maximum Length of Defect (mm)		
Single	Whole Body	59	56	54
	Gonads	19	18	17
	Thyroid	19	18	18
Double	Whole Body	135	175	27
	Gonads	44	56	87

Lambert K, McKeon T. Inspection of Lead Aprons: Criteria for Rejection. Health Physics. 2001 May;80(5 Suppl):S67-9. PubMed PMID: 11316086. Epub 2001/04/24. eng.

Tears at the seams

Cracks or tears can appear at the seams from improper use i.e. sizing is too small for the end wearer or can occur during original manufacture.

Such aprons should be returned to the manufacturer if still under warranty.

If not, consult your medical physics/radiation safety department for advice. They may recommend that the aprons be removed from service depending on their rejection criteria.

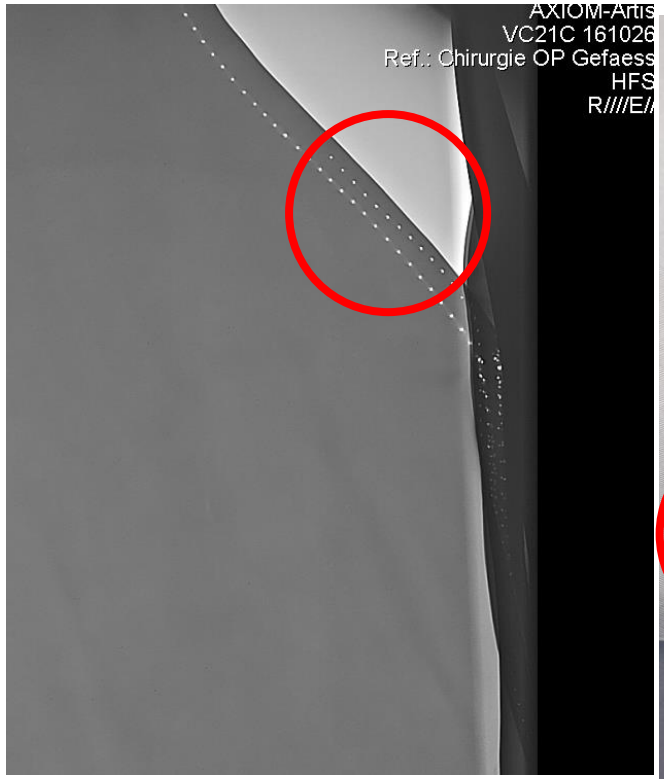
Broad lines

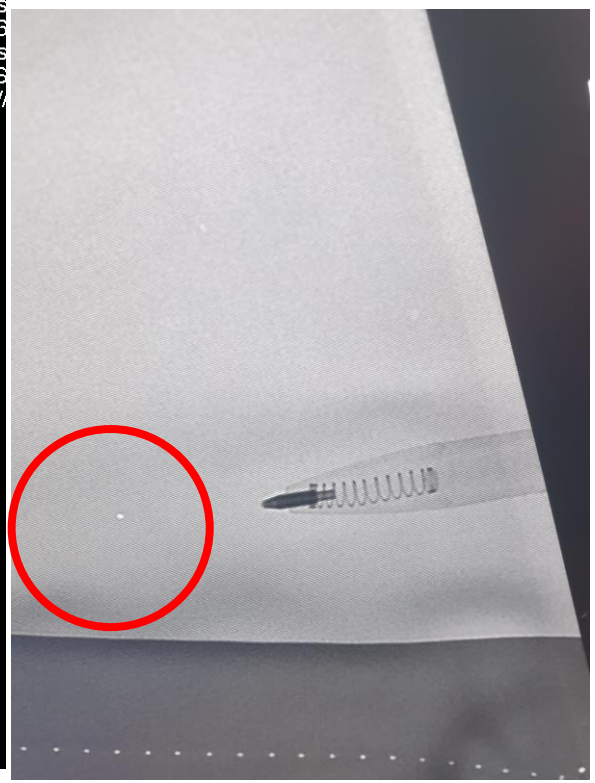
Usually ¼ " – ¾" wide, wavy and not straight, are folds in the protective layers, and they show up as lighter/whiter on X-ray, darker on fluoroscopy.

They show up as "more or thicker material" because the length of the radiation path is longer through the hypotenuse of the slope, rather than perpendicular through the sheet.

They move or disappear if the apron is flattened out and are not a defect or radiation safety matter.

Pin Holes



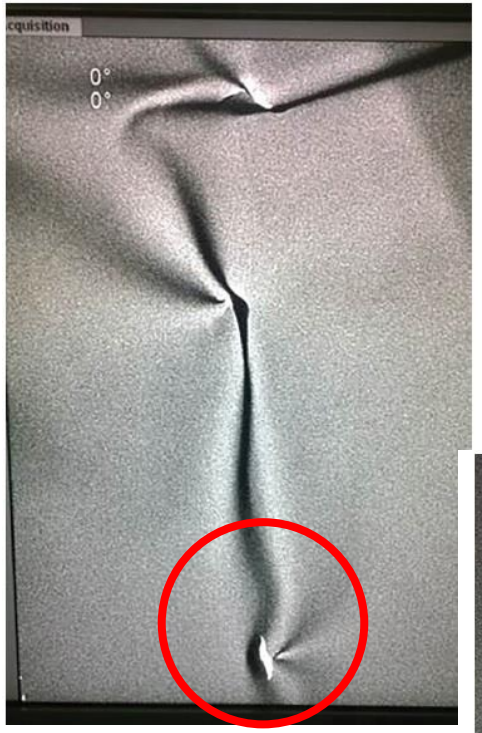


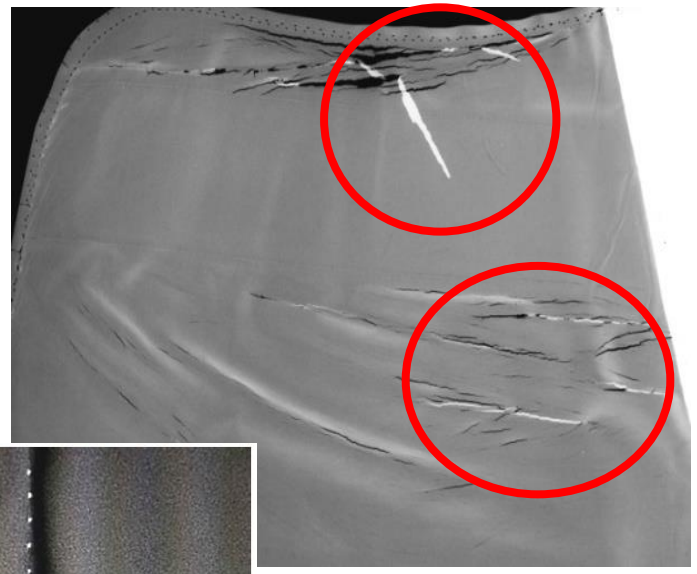
Pin holes resulting from the manufacturing process are acceptable. These pin holes should occur at the seams of the aprons to secure the binding to the exterior fabric and internal core material.

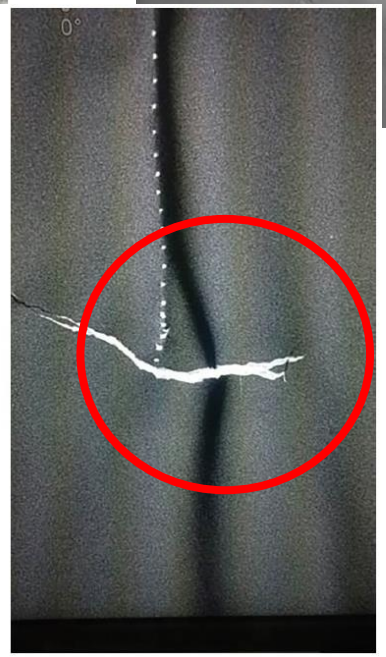
Tiny pinholes which occur away from the seams or edges (< 0.5 mm) which are “faint”, are only present in one layer of the material will not compromise radiation protection/safety or the durability of the apron. They can occur occasionally in the manufacturing processes used to make the inner protective sheets and are generally caused by a minute air-bubble trapped in the sheet or by inclusion of radiolucent particles (dirt/dust etc).

If they exceed 2 mm (real size), or appear multiple times in times in the apron, consult your Radiation Safety/ Medical Physics staff for advice.

Cracks





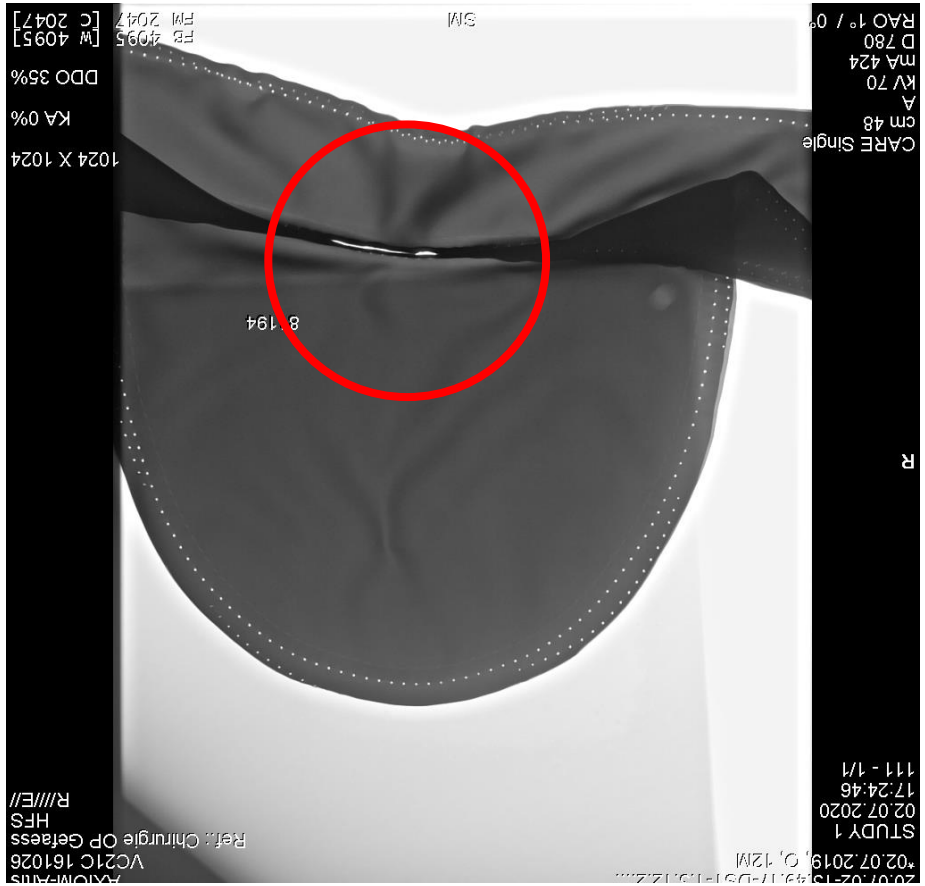


Cracks or tears can occur in the protective material at the end of its lifetime. This is usually a result of improper storage/ improper cleaning but can occur occasionally during original manufacture. Cracks form due to repeated "flexing" or if exposed to harsh cleaning products which can effect the polymer matrix causing the inner material to become more brittle.

Usually they appear as short and straight, sometimes with jagged edges, showing black on x-ray (lighter/whiter on fluoroscopy). If they exceed a certain size/location, they are a cause for concern for protection and radiation safety.

Such aprons should be returned to the manufacturer if still under warranty or taken out of service.

Thyroid screening



‘Gaps’ in core material on 1200-2 Bib Style should be treated with caution. As there are two overlapping sections of core material (as shown by the darker areas), however if the thyroid is screened vertically, the x-ray beam will slip between the two layers.

This is not a radiation safety concern as the panels overlap when worn correctly.

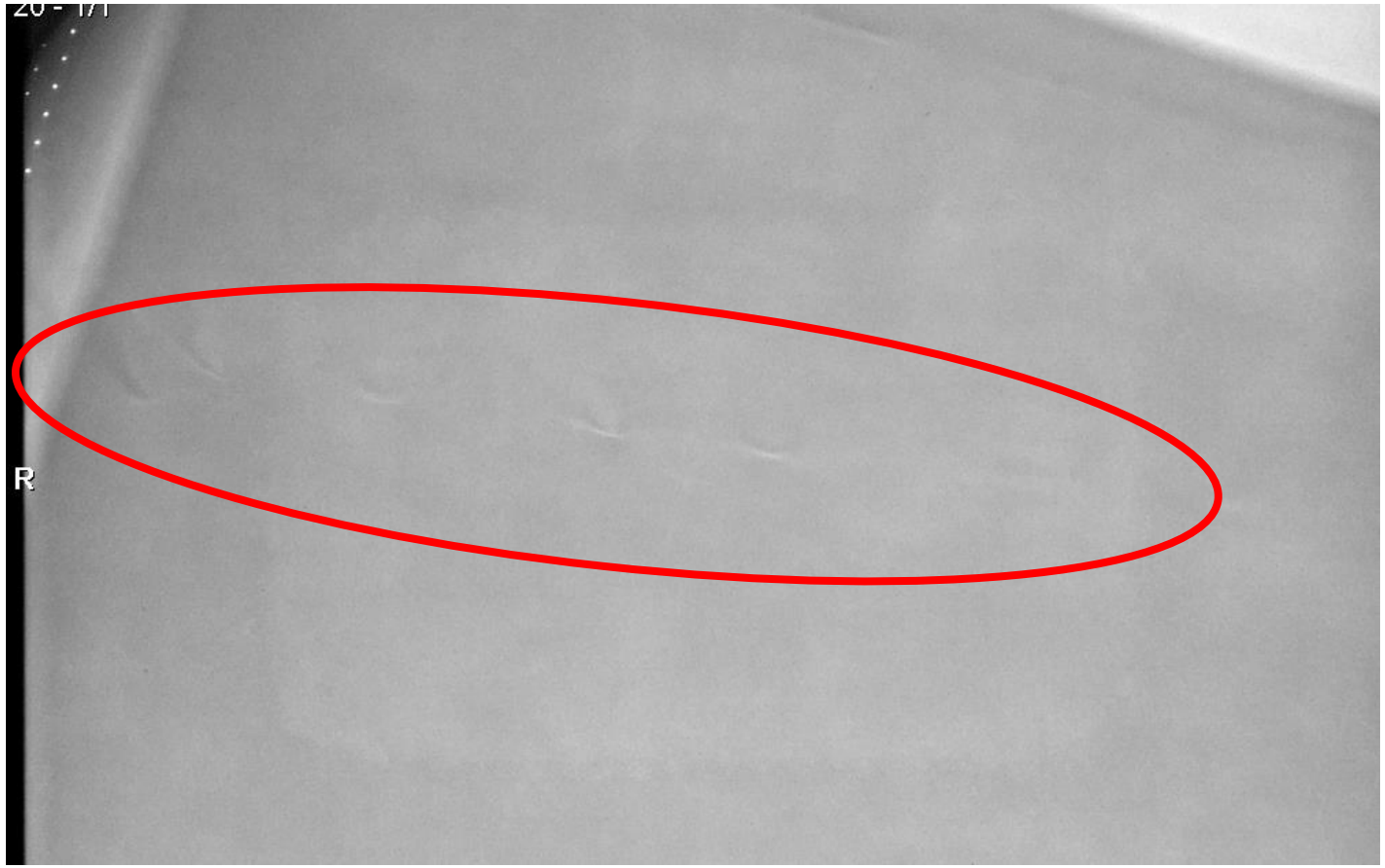
Bunching of lead

Prolonged use of an apron may result in core material bunching at the bottom of the aprons. This is because the core material is heavy, so after an extended lifetime the inner material can begin to drag/pull down and bunch at the bottom seam.

As there are no cracks or tears the protective performance of the material is not a concern. However, the user may be able to feel the bunching externally.

If this occurs, it's important to screen the top of the apron. If there are tears/cracks at the top seams, consult with your radiation safety department who may advise to remove the apron from service.

Creasing of Protective Material

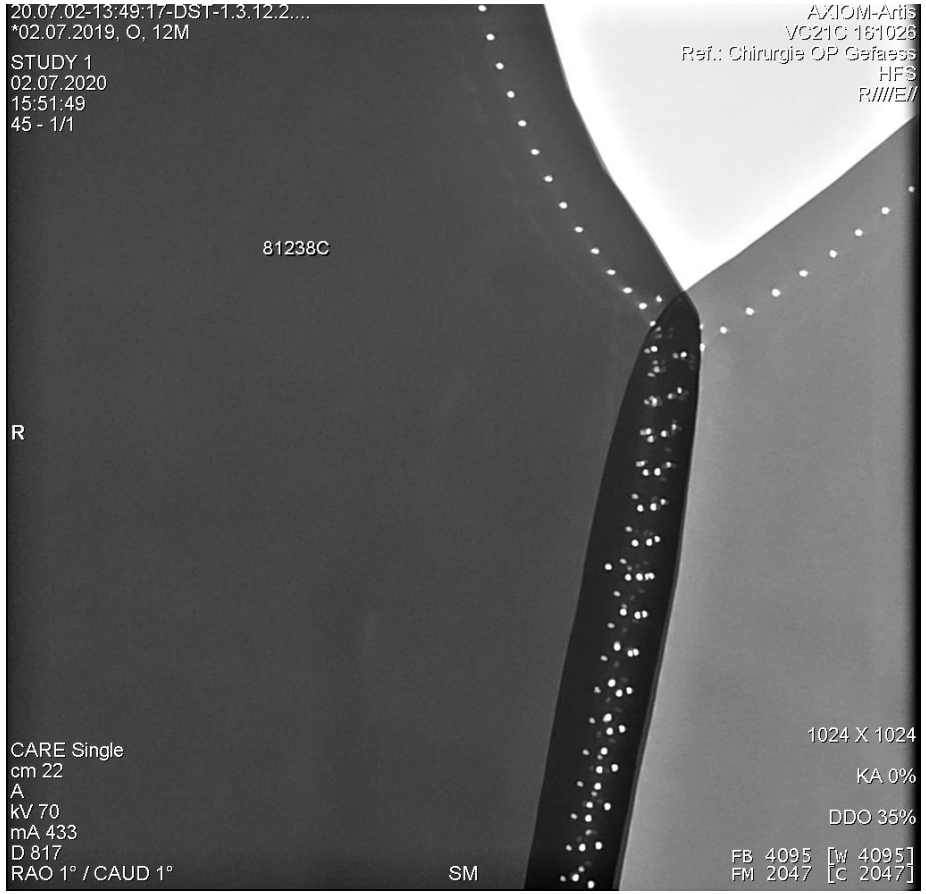


Packing of aprons can cause minor creases in the protective material due to material memory.

As there is no perforation of the material, there is no risk of elevated radiation exposure.

Aprons should be hung or stored correctly to allow creases to ‘fall out’.

Greyscale - Lead Equivalency / Thinning



Thinning of the lead and the outer protective layer of the apron also warrants rejection. Thinning is the result of prolonged use, and creates a floppy, comparatively lightweight apron that can expose the health care worker to radiation.

Thinning is determined by measuring thickness in relation to the size of the apron. The grayscale method is the easiest way to determine thinning.

It's worthy to note that some aprons have different lead equivalencies in the front and the back which will also show differences in greyscale. This picture shows a 0.50 front & 0.25 back denoted by the inner label & shoulder labels.

Need more advice?

Please contact us
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Need a way to track your inventory after screening?

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