

# X-Ray Fog



The recommendations in this document are valid for all film formats (135, Advanced Photo System, 120/220, sheet films, 400 ft. rolls, ECN, etc.).

Until recently, x-ray inspection units used for airport security have been relatively safe for films. However, as airports step up their security measures, some have introduced a new type of inspection unit that has a greater potential to fog film. To date, these units are not widespread, but we expect them to become increasingly common.

This new equipment is intended for *checked* luggage, although it is possible that boarding-gate security checkpoints will use it in the future. Because your checked luggage may be subjected to these new units, we suggest that you hand-carry your film and request visual inspection.

Historically, fog caused by x-ray radiation has appeared as lines or patterns across the width of roll film. The patterns are usually widely spaced lines followed by many more closely spaced lines. This happens because the image of the plastic core at the center of the roll and the individual laps of the film are projected onto the other laps of film in the roll.

Undulating or wavy patterns may also occur throughout the length of the roll; this happens when the film is x-rayed at an angle and the shadow from the end of the film spool and magazine alters the exposure. Shadow images from other objects may also be evident. For example, film x-rayed inside a camera may show images of camera mechanisms

The fog caused by the new airport inspection units is usually more pronounced. It typically appears as soft-edged bands  $\frac{1}{4}$  to  $\frac{3}{8}$  inch (1 to 1.5 cm) wide. Because the new equipment uses a higher and more focused x-ray beam, the banding will be very dark on negative films and very light on reversal films. Depending on the orientation of the film to the x-ray beam, the banding may be linear or wavy, and can run lengthwise or crosswise on the film. It can also undulate, depending on the combination of the angle of exposure and the multiple laps of film on the roll. However, the fog will usually lack the more subtle patterns produced by traditional types of x-ray equipment.

X-ray fog may appear as follows:

- **On Black-and-White Negative Films**—Dark areas in patterns as described above.
- **On Color Negative Films**—Dark areas with neutral or brown patterns.
- **Color Reversal Films**—Minus-density area with patterns as described above.

## CAUSES

X-ray fog can result from exposure to x-rays from medical equipment, airport inspection equipment, industrial x-ray sources, and other sources of x-rays, as well as from gamma rays from radioactive materials.

Airport x-ray inspection equipment is the most common source encountered by most photographers. Except for the new types of inspection units described earlier, most inspection units in use today are relatively safe for films with an ISO speed or Exposure Index (EI) of 400 or lower. However, multiple exposures without reorientation of the film, cumulative doses of more than five exposures, and malfunctioning inspection units can cause fog. Films with an ISO speed or EI higher than 400 require added precautions because they are much more sensitive to x-ray exposure. Even with “film-safe” x-ray units, you should limit exposure to one inspection. For films with a speed of 1000 or higher, request *visual* inspection if allowed by local regulations or law.

## OTHER CONSIDERATIONS

Other factors can affect the severity of x-ray exposures on photographic films. Film that is—or will be—underexposed and film that you intend to push-process may be particularly vulnerable to x-ray exposure.

**Underexposure.** X-ray fog occurs in the lower exposure range of the film. Film that is underexposed has more of the image recorded in this range. Therefore, the effects of x-ray exposure may further reduce the quality of underexposed images.

**Push Processing.** Push processing involves overdevelopment of film to increase the effective speed and increase the density of underexposed images. Just as overdevelopment increases image density, it will also increase the density of any fog, including x-ray fog.

Limiting x-ray exposure is increasingly important for film that may be subject to underexposure or push processing.

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## PREVENTION

At airport inspection stations, be sure to look for posted advisories on potential effects on film. Requesting visual inspection of photographic materials is still the best preventive measure, when it's allowed. For easy inspection, carry the film in a clear plastic bag.

If you choose to place your film in luggage that you will check, ask if the luggage will be x-rayed. Be aware that security procedures in some locations may prohibit informing passengers whether or not their checked luggage will be x-rayed. Because of random x-ray examination of checked luggage and differences in procedures worldwide, we suggest that you *not* carry film in checked luggage. By hand-carrying your film, you will know if it is subjected to x-ray inspection.

If possible, you may want to have your exposed film processed locally before passing through airport security. X-ray exposure has no effect on processed film.

## CORRECTION

You can compensate for any overall fog during printing of negatives, but *if the fog is significant, prints will show a loss of shadow detail and reduction in contrast*. Also, x-ray fog commonly appears in patterns; it is impossible to compensate for it in printing, because you can't separate the fog exposure from camera exposure.

## OTHER CONDITIONS RESEMBLING X-RAY FOG

- As noted earlier, exposure to the new airport security equipment produces a pronounced band of plus density or minus density that lacks the subtle patterns associated with x-ray exposure by other equipment. The fog pattern can resemble typical white-light fogging that occurs in a defined path—for example, from pinhole light leaks in equipment. The most defining characteristics of fog caused by the new equipment are the well-defined width of the bands and a fairly uniform density within the band. The banding will typically run through the whole roll (continuously or broken by patterns from the laps of film in the roll).
- On 135-size film, reverse-wind streaks are often mistaken for x-ray fog. However, these streaks are more evenly spaced and prominent, and tend to bow outward from the film perforations.
- Certain keeping conditions can produce effects that are confused with x-ray fog. However, you can usually distinguish the *more common types* of x-ray fog by its distinct patterns.
- With focal-plane shutters, using shutter speeds higher than 1/60 second under fluorescent lights or higher than 1/125 second under high-intensity discharge lamps can produce crossbanding that may be mistaken for x-ray fog. However, these crossbanding patterns are usually widely spaced and diffuse.

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