

## **DARKROOM FOG**

X-ray film used with intensifying screens is very susceptible to fogging from extraneous light. This is because the film is optimized to respond to the green, blue, or ultraviolet light emitted by the interaction of X-rays with the intensifying screens inside the X-ray film cassette. Improper safelights and light sources inside and outside of the darkroom can compromise the quality of radiographs by reducing contrast and darkening the image. Unless the facility performs fog testing as part of a quality control program, there is no certainty that the darkroom is safe for uncovered film. Facilities that provide mammography utilizing film/screen are required to perform fog tests semi-annually, but other facilities should consider testing for fog to ensure the integrity of the darkroom.

### **Sources of Extraneous Light**

Every facility that uses film screen-based radiography can take simple precautions to prevent fogging of film from extraneous light. Sources of unwanted light include:

- Incorrect or faded safelight filters;
- Cracked filters or safelight housing;
- Safelights too close to the film handling area;
- Excessive light bulb wattage;
- Thin-coated red decorative light bulbs (instead of a safelight);
- Indicator or glow-in-the-dark lights such as those on appliances, timers, radios, etc.;
- Glow-in-the-dark wristwatches or remote controls;
- Light leaks around doors, processors, vents, or pass boxes;
- Light leaks through perforated ceiling tiles or incorrectly placed tiles in suspended ceilings; and
- Fluorescent light afterglow.

### **Simple Precautions**

Check that the safelight filters are those specified by the film manufacturer. Immediately replace any filters that appear faded or cracked, and routinely replace filters at regular intervals. At a minimum, use opaque tape to cover cracks or light leaks in filters or filter housings. Some manufacturers indicate that filters should be replaced quarterly, but less frequent replacement may be adequate. Light bulbs in safelights should generally not exceed 15 watts, so as not to exceed the filter's capacity or shorten its life. Safelights should be located approximately four feet from the working surface. A red light bulb may not offer the same protection as a safelight. The film manufacturer will have specific recommendations. If the darkroom is equipped with fluorescent lights, turn on the lights for two minutes. With the door closed, turn off the lights and check for an afterglow. If one is visible, either the lights should be replaced with incandescent lighting or the darkroom procedure should be modified to allow an elapse of time for the glow to subside. Remember to perform this test again whenever a fluorescent bulb is replaced. Wait several minutes for your eyes to adjust to the darkness. Remember, the eye is most sensitive when using peripheral vision to look for weak light sources, so do not stare directly at the source. Look for obvious light leaks around doors, vents, the processor, and in the ceiling. Be sure to look from more than one position, as leaks may be visible from one angle but not from another. Correct any light leaks that are visible. Reflected light from tiled, chromed, or mirrored surfaces may also cause a problem. Remember, a darkroom need not be totally dark; only the portion of light in the color range to which the film is sensitive needs to be eliminated. Unfortunately, common sources of white light contain all colors.

### **Eliminating Light Leaks**

Elimination of light leaks can be a challenge and may require some ingenuity. A solution at one facility may not work at another facility. Adhesive foam tape, rubber door sweeps, rubber gaskets, and wooden molding may be useful around doors. Heavy tape, cardboard, fabric, or caulking may work elsewhere for light leaks. Flat black paint minimizes reflected light.

## Fog Test

The only way to be certain that fog from extraneous light is not a problem in the darkroom is to perform a fog test. One method of testing for fog is the two-minute test. All fog tests use an exposed film to determine the level of fog. *Unexposed, underexposed, or overexposed film is much less sensitive to the effects of darkroom fog.* Load a cassette using film from a fresh box of film. Expose cassette so that the background density is between 1.0 and 1.5 Optical Density (OD) units or medium gray. Experimentation may be necessary to determine the best techniques to achieve the correct density, and it may be necessary to place a “phantom,” such as a block of acrylic, in the beam. A low peak kilovoltage (e.g. 50-56 kVp) and 5 milliamps per second (mAs) or less at 40” Source to Image Distance is a technique that may produce the desired results. Another alternative is to take an image of a step wedge at a higher kVp (about 80) or higher mAs. This will ensure that a region of optical density between 1.0 and 1.5 will appear somewhere within the image of the wedge. With the safelights on, place the exposed film on the counter top in the darkroom. Cover half of the film with the cassette or with an opaque card. Using a stopwatch, timer, or wrist watch, allow two minutes to elapse. Process the film in the usual manner. If more than one type of film is used at the facility, this test should be performed with each type of film. The results from one type of film can be entirely different than those for another type of film. Mammography facilities should reference the American College of Radiology [Mammography Quality Control Manual](#) for testing darkroom fog.

## Interpreting Results

A film that has been fogged will have a clear delineation between the covered and uncovered portions of the film. The untrained human eye can discriminate a difference of 0.02 OD. An optical density difference between the covered and uncovered portions should be no greater than 0.05 OD when measuring with a densitometer. Any difference greater than 0.05 OD is cause for concern and the quality of the radiographs may be less than optimal.

If a densitometer is not available to measure the density differences, interpretation is subjective. A 0.05 OD difference is quite obvious and would clearly indicate to the viewer that improvements should be made. The source of the problem should be located and corrected. Of course, if no line or variation is visible, fog from extraneous light is not a problem and the darkroom is safe enough to leave film uncovered for at least two minutes, no matter how bright it may seem inside.

If fog is found on the film:

- The test should be repeated with the safelights turned off.
- If the fog disappears, the problem was caused by the safelight.
- If the fogging remains constant, the problem is being caused by a light leak or by other light sources in the darkroom, such as indicator lights.
- If the fogging was reduced, but still significant, the cause may be due to a combination of problems. If this is the case, several tests may need to be made under different lighting conditions in order to find and eliminate all of the sources of fog.

## References:

- Dupont Diagnostic Imaging. [Darkroom Technique: For Better Radiographs Processed Manually or Automatically](#)
- Perry Sprawls, Jr. 1993. [Physical Principles of Medical Imaging](#). 2nd ed. Gaithersburg: Aspen Publishers, Inc.
- American College of Radiology. 1999. [Mammography Quality Control Manual](#)

For more information, contact the Bureau of Radiation Protection at 717-787-3720 or visit [www.dep.pa.gov](http://www.dep.pa.gov).