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Mammography Tech Tips

How can I use a duplitized emulsion with one screen?

With KODAK MIN-R EV Film, the primary emulsion is placed next to the screen the same way as MIN-R 2000 film. This emulsion images breast parenchyma up to an optical density of 3.0. The backside emulsion crosses over to image the upper density and D-Max. The emulsions are different speeds and composition so no interaction will occur. The coating technology is similar that used presently with KODAK MIN-R L film.

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What is the difference between the new KODAK MIN-R EV mammography film and KODAK MIN-R 2000 mammography film?

MIN-R EV film uses novel emulsion technology to achieve higher mid, lower and upper scale contrast for improved detection of abnormalities. MIN-R EV film is an assymetrical dual emulsion film for use with a single screen. MIN-R EV screens have improved sharpness versus MIN-R 2000/2190 screens. **The film is slower and the screens are faster than the MIN-R 2000 film screen systems**.

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Mammography Tech Tips

Which Kodak mammography film provides the highest average gradient?

KODAK MIN-R EV Film is Kodak's highest contrast mammography film. It yields the following average gradients when paired with the indicated processing chemistry:

- KODAK X-OMAT EX II Developer and Replenisher
  MIN-R EV Film = 4.7
  MIN-R 2000 Film = 3.8
  MIN-R L Film = 3.6

- KODAK RP X-OMAT Developer and Replenisher
  MIN-R EV Film = 4.5
  MIN-R 2000 Film = 3.6
  MIN-R L Film = 3.4

Note: these values are based on internal Kodak testing and are for comparison purposes only.

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Mammography Tech Tips

Which Kodak mammography film provides the highest quality?

KODAK MIN-R EV Film is Kodak's sharpest and most detailed high-contrast film for mammography imaging, making it the ultimate choice for enhanced visualization and easier detection. Used in combination with KODAK MIN-R EV 150 or 190 Screens and processed following Kodak recommendations, it provides the highest mammography imaging quality. As part of the KODAK MIN-R EV Screen-Film System, it helps enhance confidence in the interpretation while meeting demanding quality control and accreditation standards.

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Mammography Tech Tips

What has the greatest effect on radiographic contrast: kVp or optical density?

If you have performed the optical density and kVp procedures as outlined in preceding Tech Tips, you'll notice that changing the kVp results in very little change to radiographic image contrast while changing the optical density results in the perception of a significant contrast change. Contrary to widely held beliefs, kVp may have a minor influence on overall contrast when using a combination of molybdenum and rhodium for anodes and filters in mammography. However, optical density has a major influence on perceived contrast.

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Mammography Tech Tips

How does changing the kVp affect image quality?

It is usually expected that lower kVp will produce the best contrast. However, new higher-contrast films may now make it desirable to use higher kVp to lower dose, or comply with exposure regulations, while maintaining high image quality.

The following procedure can be used to assess the effect of kVp on image quality. The procedure will produce phantom images that will be helpful in determining the highest kVp acceptable before image quality is adversely affected.

(NOTE: Filtration also changes the energy spectrum, and so impacts image contrast. The following procedure can be adapted to explore the impact of filtration changes on image quality by adjusting the filtration between exposures at a given kVp. See below.)

The following procedure assumes that the kVp is accurate and that the x-ray unit automatic exposure is reproducible.

1. Assemble the tools needed:
   - Mammographic phantom (e.g., accreditation phantom and/or anthropomorphic phantom).
   - Mammographic cassette of the type used clinically (the same cassette should be used for all exposures).
   - Fresh box of KODAK MIN-R EV Mammography Film (all images must be made using the same emulsion).
   - Spot reading densitometer.
   - Image mask—Prepare by exposing a 35 x 43-cm film to light, processing the film, and cutting the mask and films to accommodate the images.
   -

     NOTE: Mask to the edge of wax insert if using the ACR accreditation phantom.
2.

2. For each exposure, in the darkroom under appropriate safelighting, load a sheet of film into a clean mammographic cassette. Wait at least 5 minutes prior to each exposure.
3.

3. Prepare to make the first exposure:
   - Place the cassette into the moving grid cassette holder of the mammographic unit.
   - Position the phantom on top of the grid.
   - Lower the compression device until it contacts the top of the phantom. Ensure that all the images are taken with the same compression, preferably disabling the compression release if possible.
   - Position the photoreceptor so it is centered underneath the phantom.
   - The maximum exposure time of any image should not exceed some predetermined value, such as 2 seconds.

NOTE: The target optical density should be as typically used clinically. Each image in the following series should be within 0.05 of the target optical density.

4. Expose a series of phantom images in an auto-time mode of the AEC varying the kVp by one kVp increment, from the lowest kVp to the highest (i.e., 24 to 32 kVp).
5.
5. View the masked phantom images by placing them sequentially, labeled with the kVp used, on an illuminated viewbox used for mammography in a darkened room.
6.
6. Identify the image that shows the greatest amount of information (details). The kVp and optical density of the preferred image may indicate the best technique for the phantom on the specific piece of mammographic x-ray equipment used.
7.
7. Verify that the selected kVp produces adequate contrast in clinical images by making several clinical exposures at that kVp setting. If more contrast is desired, consider lowering the kVp. If less contrast is desired or could be tolerated, the kVp could be lowered.

   To evaluate the effect of filtration changes:
   For a selected kVp, make an additional image in which a second filtration option is selected. Compare that image with the filtration setting of the reference technique.

   The above procedures can be a guide to selecting optimal kVp according to the specific phantom used, which simulates one specific breast thickness and type only. The use of one kVp for all breast types, however, is not recommended. Your facility should establish an optimal kVp range for different breast thicknesses and densities.

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Mammography Tech Tips

What is a practical method for optimizing exposure?

The following procedure will help you establish the preferred optical density for a particular screen/film and viewbox combination. This procedure assesses the effect on image quality of changes in optical density by producing phantom images for evaluation. Once a desirable density is achieved with the phantom, it is verified with clinical images.

The specific optical density choice at a given facility will be heavily dependent on viewing conditions and radiologist preferences. Because KODAK Mammography Film will produce high-quality images over a range of optical densities, it provides the flexibility for meeting individual needs.

1. Assemble the tools needed:
   - Mammographic phantom (e.g., a phantom that adheres to the ACR mammographic accreditation phantom and/or anthropomorphic phantom).
   - Mammographic cassette of the type used clinically (ideally, the same cassette should be used for all exposures).
   - Fresh box of KODAK Mammography Film (all images must be made using the same emulsion).
   - Spot-reading densitometer.
   - A mask for the images, prepared by exposing a 35 x 43 cm film to light, processing the film, and cutting the mask and films to accommodate the images.
     NOTE: Mask to the edge of wax insert if using the ACR accreditation phantom.
2.
2. For each exposure, in the darkroom under appropriate safelighting, load a sheet of film into a clean mammographic cassette. (If using an improved KODAK MIN-R 2 Cassette, wait at least 5 minutes prior to each exposure; wait at least 15 minutes prior to each exposure if using a KODAK MIN-R Cassette.)
3.
3. Prepare to make the first exposure:
   - Place the cassette into the moving grid cassette holder of the mammographic unit.
   - Position the phantom on top of the grid.
   - Lower the compression device until it contacts the top of the phantom. Ensure that all the images are taken with the same compression, preferably disabling the compression release if possible.
   - Position the photoreceptor so it is centered underneath the phantom.
   - The maximum exposure time of any clinical contact (not magnification) image should not exceed some predetermined value (e.g., 2 seconds).
     NOTE: The kVp and filtration should be fixed between all images at settings typically used for clinical images. The next section describes a procedure for evaluating kVp and filtration.
4.
4. Expose a series of phantom images using phototiming (automatic exposure control) in a fixed kVp mode (e.g., 26) and varying the density control setting. For example, make

exposures using the –2, –1, 0, +1, and +2 settings on the density control. Aim for the background optical density of all phantom images to range from a minimum of 1.2 to approximately 2.2. Use the densitometer to check the actual optical density in the center of each image.

5.

5. Sequentially place the masked phantom images, labeled with the optical density used, on an illuminated viewbox used for mammography in a darkened room.

6.

6. Identify the image that shows the greatest amount of information (i.e., details). The optical density of the preferred image may indicate the optical density that should be used clinically.

7.

7. Verify that the selected optical density produces adequate contrast in clinical images by making several exposures with the settings that produce that optical density in the phantom. It may be necessary to increase the optical density if glandular tissue is under-penetrated, or lower the optical density if fatty tissue is overexposed.

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Mammography Tech Tips

How should I optimize viewing conditions?

The viewbox is an integral part of the mammography **imaging chain**. Attention to several factors relating to the viewbox can help ensure optimal conditions for viewing and interpreting mammographic images:

- Evaluate lightboxes for cleanliness, light output, and consistency; clean the interiors and surfaces, and replace lightbulbs on a regular schedule and as needed. *NOTE: ALL lightbulbs should be replaced whenever it is necessary to change one lightbulb.*
- Match the intensity for all viewing panels, both within and between viewboxes.
- To help ensure adequate exposure, match the intensity of technologist/radiographer viewboxes with that of the radiologists' viewboxes used to interpret images.
- While there is no universal standard for viewbox luminance, the ACR suggests a luminance of 3000 cd/m ^{2} in mammography.
- Use masking materials and equipment to control extraneous light.
- Control ambient light within all viewing areas.

For additional recommendations and evaluation of the viewbox, obtain and consult the instructions in the *KODAK Viewing Conditions Test Tool*, Kodak publication No. M7-207, CAT No. 150 1915.

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Mammography Tech Tips

How do viewing conditions affect the perception of clinical image quality?

Viewing conditions are critical to effective visualization of an image captured on film. Viewboxes should be adequately bright and uniform across the entire viewing area. While there is no universal standard for viewbox luminance, the ACR suggests a luminance of 3000 cd/m^2 in mammography. According to the *ACR Mammography Quality Control Manual* (American College of Radiology, 1999), pages 292–294, this is sufficient to see details up to an optical density of only 3.1.

Viewbox luminance [cd/m^2]	Maximum optical density at which details can be visualized
1500	2.80
3000	3.10
7000	3.4+

To adequately see details of higher optical density—especially in fatty regions and breast periphery—a bright light is needed. In addition, it is critical to reduce ambient and stray light from unmasked areas of the viewbox as they will lower perceived contrast across the image.

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Mammography Tech Tips

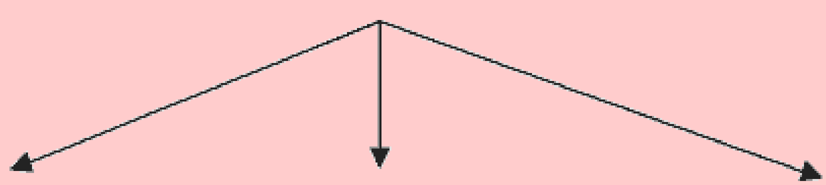
What is radiographic contrast?

Radiographic contrast is dependent upon all components of the imaging chain.

- *Subject contrast*—the contrast between objects in the image as a result of differing x-ray attenuation. This is influenced by the choice of x-ray spectral properties such as filter and kilovoltage selection.
- *Film contrast*—the response of the film. For a given image, this is dependent on the exposure level as well as inherent film contrast.
- *Display contrast*—perceived contrast as the image is viewed. This is influenced by ambient and stray light from unmasked areas of the viewbox.

To optimize overall radiographic contrast, the x-ray spectrum should be carefully chosen. The target film optical density of the exposure control circuit also should be selected according to the film response characteristics and subject. In addition, the film contrast must be balanced against the viewing conditions.

Radiographic Contrast



Subject Contrast	Film Contrast	Display Contrast
Spectral Properties • kVp • Target • Filtration Object Properties • Thickness • Composition	• Optical Density (exposure level) • Characteristic response (determined by type of film and processing)	Viewing Conditions • Brightness and uniformity of the viewbox • Masking • Reduction of ambient light

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Mammography Tech Tips

What key factors contribute to the perception of a high-quality mammography clinical image?

There is no current standard or single set of technical factors specified for optimal image quality. In practice, key technical factors should be adjusted based on breast composition and thickness, so it's important to have a basic understanding of how these technical factors affect image quality. This is true even when using automated exposure modes.

Key factors contributing to the perception of a high-quality image include contrast, detail, and noise. Many of these variables can be controlled with the choice of screen-film combination and establishment of a proper processing environment, including the following steps:

- **Ensure proper and consistent processing of the film**
  For Kodak mammography films, proper processing conditions are defined in KODAK Service Bulletin No. 30. Best results will be achieved by following these processing recommendations, including proper conversion and setup of the processor, and adjustment of replenishment rates according to film volume and mix. With a regular quality control program for film processing, processing conditions can be monitored and adjusted as variations are identified.

- **Ensure proper functioning of x-ray equipment**
  A physics survey, including kVp accuracy and automatic exposure control (AEC) performance, should be performed and any recommended changes implemented prior to establishing optical density and technical factors. The x-ray equipment should be calibrated specifically to the Kodak film/screen combination in use. In addition, a physicist and the x-ray equipment service representative should check the x-ray unit on an ongoing basis or according to regulatory mandates.

- **Ensure good positioning (especially proper compression)**
  Good positioning is essential to high-quality mammography. Not only will the amount of tissue be maximized for each view, but uniform compression will be applied. Firm/taut compression reduces the potential for motion blur, scattered radiation, and the range of exposure that must be recorded on the film. Positioning of the detector under the densest part of the breast helps to ensure that the breast parenchyma will be penetrated. All of these factors contribute to higher image quality, especially when contrast films are used. Many mammography x-ray units with automatic technique selection features use the compressed breast thickness in determining the technical factors for the image, making proper breast

compression critical to consistent image quality.

X-ray exposure factors also need to be selected to make optimal use of the contrast and noise properties of the film, with consideration for constraints due to equipment capabilities or dose requirements. In this area, key factors relate to the spectral properties of x-ray exposure, exposure level, and viewing conditions.

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I failed the darkroom fog test. What could be wrong?

Several factors can affect test results. The following suggestions may prove helpful:

1. **Check for light exposure from sources other than safelights**
   Close the door and turn off the lights. Note any light leaks and take corrective action to eliminate them. Sources to consider include light leaks around doors, cracks in walls, and cracks where ceiling partitions join walls.

2. **Check that you are using the appropriate safelight filter.**
   A KODAK GBX-2 Safelight Filter, or equivalent, is the correct safelight filter for all KODAK Mammography Films.

3. **Check that the filter is installed correctly.**
   Filters should be installed so that the identification printing can be read when looking at the lamp. If the filter orientation is reversed, excessive heat buildup inside the lamp housing may cause the dye layer to crack and thus leak unsafe light.

4. **Check the filter for cracks or fading.**
   Safelight filters can fade and crack with age, or due to heat from incandescent bulbs.

5. **Use the appropriate wattage bulb.**
   Oversized bulbs can damage the safelight filter due to excessive heat. A 7.5-watt incandescent bulb is recommended for all KODAK Mammography Films.

6. **Check the distance of the safelight from the work surface.**
   The distance of the safelight from the work surface, and the direction of the light with relation to the work surface, can affect results. Also consider directing the safelight toward the ceiling.

7. **Use the appropriate number of safelights for the size of your darkroom.**
   In large rooms with white ceilings, place no more than one lamp for every 64 square feet (6 square meters) of ceiling area. You can use a number of safelight fixtures (with the correct filter and bulb) if they are at the proper distance from the work surface and are placed at least 8 feet (2.5 meters) apart.

8. **Check for other sources of fog.**
   Occasionally, automated processors will vibrate sufficiently to cause small openings between the light seals and the adjoining partition. Another possibility is that the processor cover may not be tightly closed. Also, afterglow from some types of fluorescent lights can cause fogging, as well as glowing lights or dials on equipment located in the darkroom.

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What is the darkroom fog test?

This test is used to determine if safelight fog, which can affect film consistency and overall contrast, is present in a darkroom. It should be performed at least semiannually after evaluating and eliminating any obvious light leaks.

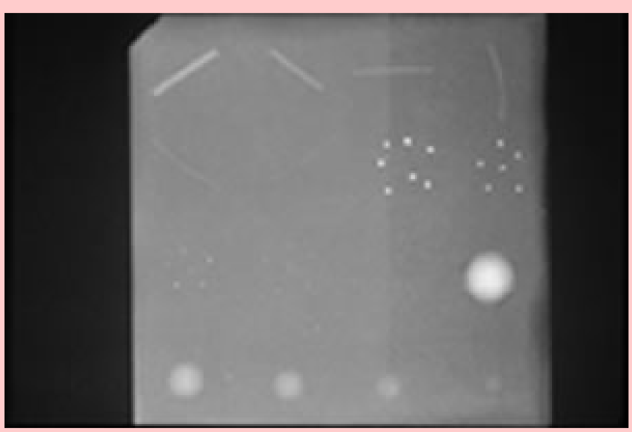
Tools

Mammographic X-ray unit
Phantom
Mammography cassette
KODAK MIN-R 2000 Film
Mask/cardboard (must be opaque)
Stopwatch or timing device
Densitometer

Procedure

- Turn off safelight(s).
- Load the film into the cassette in total darkness.
- Expose the film and cassette to the appropriate optical density.

> The film should be exposed to an optical density of between 1.2 and 2.0. This density range is appropriate regardless of the optical density used for other phantom tests. Adhering to this density range is especially important for high-contrast mammography films such as KODAK MIN-R 2000 Film.



- With safelights still off, remove the exposed film.
- Place on counter emulsion side up.
- Cover one-half of the phantom image with the mask.

- Turn on safelights.
- Wait two minutes.
- Remove mask.
- Process film.
- Using the densitometer, measure the difference between the fogged and unfogged areas.
- Calculate the difference in density.

Performance Criteria
The difference in optical density should not exceed 0.05.

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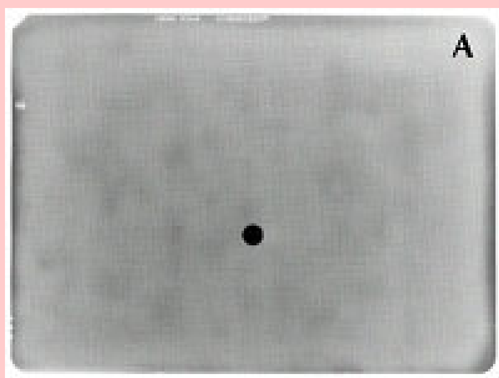
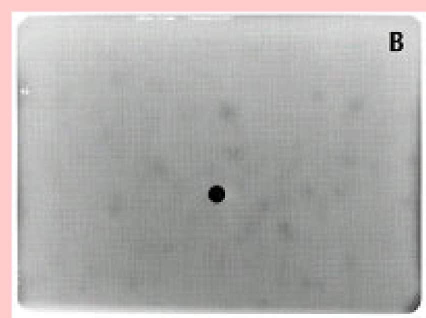
When I Perform the Screen-Film Contact Test There Are Multiple Spots. Is That Okay?

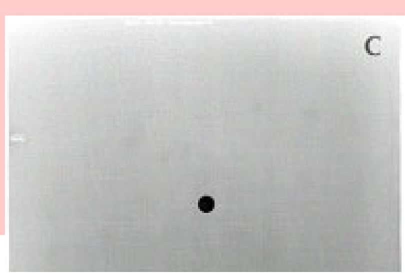
Trapped air and dust specks can cause multiple spots, and necessitate repeating the test. Use the accompanying photographs, representative of typical screen-film contact radiographs, to assist you in evaluating your own contact radiographs. (Note: The letters A, B, and C on the photographs denote the right-hand corner of the non-chest-wall side of the radiographs.)



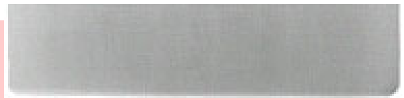
Photograph A demonstrates a diffuse increased density pattern throughout the entire image. This is representative of air trapped between the intensifying screen and film emulsion, and may occur if the screen-film contact test radiograph is taken too soon after loading the cassette. The test should be repeated after waiting at least 15 minutes to obtain more accurate results. Photograph A also demonstrates that it is critically important to manage your mammography cassettes during clinical use so that they have been loaded at least 15 minutes prior to patient exposure. If using improved KODAK MIN-R 2 Cassettes, exposures may be taken after waiting 5 minutes.



Photograph B corresponds to a radiograph taken after the cassette has been loaded for at least 15 minutes and shows multiple small areas of increased density. The cassette, however, was not cleaned first. Small dust specks have caused some of the areas of increased density, particularly those located to the right and slightly below the circular cutout area. The screen and cassette should be thoroughly cleaned and then re-tested after the proper waiting period. If the contact radiographs from a cassette that has been cleaned several times still look like Photograph B, however, the cassette passes since all areas of increased density are less than 1 centimeter in diameter.



Photograph C represents good screen-film contact test results. Such results are possible when cassettes and the darkroom environment are very clean, and the relative humidity of the darkroom has been controlled at approximately 45% year-round.



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How Should I Perform the Screen-Film Contact Test?

The screen-film contact test must be performed semiannually and prior to using new cassettes. The procedure requires a special test tool, which consists of a fine copper wire mesh (40 wires per inch) mounted between two thin acrylic sheets.

> Note: Screen-film contact test tools are commercially available from several sources. Tools with or without a 1-centimeter hole are acceptable. The tool should be stored flat to prevent bowing.

Test Procedure

1. Thoroughly clean screens and cassettes first—foreign matter as small as 20 micrometers (i. e., much smaller than a human hair which is approximately 70 micrometers) will affect test results. Each cassette should have a unique identification number that will be visible on the contact radiograph. Use the following cleaning procedure:

    a. Choose a clean location. If working on a darkroom countertop, wipe the outside of cassettes and clean the countertop prior to cleaning the screens.
    b. Use a KODAK MIN-R Screen Cleaner Wipe (or moisten a second lint-free wipe with a small amount of KODAK MIN-R Screen Cleaner Solution). Clean and dry the screen. Any time 70% isopropyl alcohol is used on the screen, a KODAK MIN-R Screen Cleaner Wipe or KODAK MIN-R Screen Cleaner must be used afterwards. Avoid excessive rubbing, abrasive wipes such as surgical gauze pads, pouring of any solutions directly onto the screens or into the cassettes, or using an excessive amount of any solution.
    c. Clean the inside plastic cover of the cassette (tube-side panel) using a lint-free wipe that has been moistened with water. Dry the cover.
    d. Inspect the screen and cassette cover for any stray particles of dust. An ultraviolet light is helpful in determining if screens and cassettes are dust free. Observe all safety precautions recommended by the ultraviolet light manufacturer, i.e., do not look directly at the light; limit the length of exposure, etc.
    e. Load the cassette with film.

2. Prior to performing the test, **wait 5 minutes** after loading to allow entrapped air to dissipate from KODAK MIN-R 2 cassettes. If using MIN-R 2 Cassettes put into service prior to 1999, or KODAK MIN-R Cassettes, **wait at least 15 minutes** after loading the cassettes.

3. Place each cassette on top of the image receptor (bucky with grid) or in the non-grid cassette holder with the test tool directly on top of the cassette.

4. Move the compression device close to the x-ray tube. Additional acrylic sheets may be placed on top of the compression device to achieve minimum exposure time and the required optical density.

5. Select a manual technique to produce an optical density between 0.70 and 0.80 measured with a spot-reading densitometer over the wire mesh. The densitometer must have an aperture of 2 millimeters or greater in diameter. Use 25 to 28 kVp, and a reasonable exposure time (0.5 second, for example) to ensure a reproducible optical density on all contact radiographs. Extremely short exposure times should be avoided. Measure an area of the film near the chest wall, which represents good contact (i.e., does not show increased density).

6. View the radiographs on a viewbox from a distance of at least 3 feet.

Evaluating Your Contact Radiographs

If any of your screen-film contact radiographs show areas of increased density, repeat the test after cleaning the cassettes in question a second time and waiting at least 15 minutes after loading with film. Make sure the optical density of all contact radiographs is within the 0.70 to 0.80 range measured near the chest wall. Compare the radiographs. Cassettes with persistent large areas of increased density (greater than 1 centimeter and in the same location) should be replaced.

Contact radiographs that show multiple random areas of increased density, but all less than 1 centimeter in diameter, should be returned to service. Small areas of increased density are usually caused by minute dirt particles and will not occur in the same exact areas in comparing the first and second radiographs of a particular cassette. The use of an ultraviolet light is suggested on the insides of these cassettes after unloading to highlight any small dirt particles.

Any cassette and screen with questionable results should be cleaned and re-tested several times following the proper procedure, and the radiographs compared. Areas of increased density that shift to a different location or disappear are probably due to foreign matter or entrapped air interfering with the contact. Screens and cassettes should always be handled with reasonable care to ensure optimal mammographic image quality.

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What Is the Best Way to Clean My KODAK Mammography Intensifying Screens?

For best results, follow the recommendations below when cleaning KODAK MIN-R and MIN-R 2 Cassettes in which KODAK MIN-R, MIN-R 2000, or MIN-R 2190 Screens are mounted. ***New screens and cassettes must be cleaned prior to first use and prior to screen/film contact test.***

1. Choose a clean location.

- If working on a countertop in the darkroom used for processing mammography film, wipe the outside of the cassettes and clean the countertop with a damp cloth prior to cleaning the screens.
- Manage cassettes so they are empty at the time of cleaning (end of the day is usually best).
- Avoid replacing film previously loaded into cassettes back into the film box or film bin, since this could introduce dust into the film supply.

2. Clean the inside plastic cover of the cassette (tube-side panel) using a KODAK MIN-R Screen Cleaner Wipe or a lint-free wipe that has been dampened with a small amount of KODAK MIN-R Screen Cleaner. If dust is noted at the screen chest-wall edge, very carefully clean under the foam using a cotton swab or compressed air.

3. Dry the cover. You may want to use a camel's-hair brush or other soft lint-free brush to remove any dust accumulated in the corners of the cassette cover and along the hinge, as dust in these areas may be hard to reach with a dampened cloth.

4. Gently rub across the screen with a KODAK MIN-R Screen Cleaner Wipe (or a lint-free wipe moistened with a small amount of KODAK MIN-R Screen Cleaner).

- Avoid the use of abrasive wipes such as surgical gauze pads.
- Avoid excessive pressure or rubbing on the screen.
- Avoid pouring the screen cleaner directly onto the screens or cassettes.
- Use the minimum amount of screen cleaner needed to moisten the wipe (excess screen cleaner will not improve screen cleanliness, will prolong the drying period, and may stain the screen).
- Clean around any labels on the screen (e.g., those used to individually number the cassettes).
- DO NOT WIPE THE SCREEN DRY. Allow the screen surface to air-dry to achieve the full effects of the screen cleaner.
- A **solution of 70% isopropyl alcohol** may be used occasionally to remove stubborn dirt or

dust. After using 70% isopropyl alcohol, a KODAK MIN-R Screen Cleaner Wipe (or a lint-free wipe moistened with a small amount of KODAK MIN-R Screen Cleaner) must be used following the procedure outlined above.
The use of 70% isopropyl alcohol should be limited to occasional use only.

5. Stand the cassettes on edge to dry.

- Allow the screens and cassettes to completely air-dry before returning them to service.
- Loading film into a cassette with wet screens may damage the film and lead to staining of these screens.

6. Inspect the screen and cassette cover for any stray particles of dust.

- An ultraviolet or black light is helpful in determining if screens and cassettes are clean. ***Limit exposure to the ultraviolet light and observe appropriate safety precautions for eyes, face, and exposed skin; do not look directly at the light.***

7. Reload the cassette with film.

- If using improved KODAK MIN-R 2 Cassettes, wait at least 5 minutes after loading before using.
- If using KODAK MIN-R Cassettes or an older version of KODAK MIN-R 2 Cassettes, wait at least 15 minutes before using.
NOTE: Improved KODAK MIN-R 2 Cassettes have a rounded latch lever. The older version has an angular latch lever.

8. Reclean the countertop if the cleaning procedure was done in the darkroom.

9. Between regular cleanings, a camel's-hair brush may be used to remove dust particles from the cassette and screen surface. Care should be taken when using any brush to protect the screen surface from scratches, which will degrade image quality.

10. Each intensifying screen and cassette should be marked with a unique number to facilitate locating a specific cassette suspected of requiring cleaning or inspection.

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How Often Should I Clean My Mammography Intensifying Screens and Cassettes?

Maintaining the interiors of mammography intensifying screens and cassettes will reduce the occurrence of minus-density artifacts (e.g., shadow images) caused by dust or dirt. Therefore, they should be cleaned at least once a week, or more frequently as necessitated by environmental conditions, following the manufacturer's recommendations.

For effective cleaning and prolonged screen life, use only the screen-cleaning solution and other products specified by the manufacturer (e.g., KODAK MIN-R Screen Cleaner Wipes or KODAK MIN-R Screen Cleaner).

If screens need to be cleaned more than once a day, attention to the darkroom environment itself may be necessary (see Tech Tips on darkroom hygiene and reducing dust and dirt part 1 and part 2).

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When should I reset my aims?

Aims should be reestablished if any of the following change:

- film brand/type
- chemical brand/type
- replenishment rates
- specific gravity automixer settings
- film volume
- optical density
- sensitometer and/or densitometer
- processing cycle

Note: Replacement of chemistry (same brand/type) as part of routine preventive maintenance should not necessitate establishment of new operating levels.

If new aims are established, it is important to validate that the clinical image quality is still acceptable!

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What are the prerequisites for establishing processor QC aims?

Prior to establishing processor control limits, it is imperative that the processor be set up according to the film manufacturer's recommendations. (For KODAK Mammography Films, please review Service Bulletin No. 30 and the appropriate film conversion instructions.)

Phantoms and clinical images must also be acceptable.

In addition, the processor should be "seasoned," i.e., in equilibrium. The "seasoning effect" (the change in QC values between a fresh developer startup and the developer once it has reached equilibrium) is the rationale for averaging QC strips from multiple days to establish a baseline for MD/DD/B+F. Interim aims are used to monitor the process until seasoning occurs.

Seasoning is dependent on a variety of factors: chemistry, replenishment rates, film optical density, and the area of exposed film. The use of starter accelerates the seasoning process. For additional information, refer to the KODAK MIN-R 2000 Film System User Guide, Pub. No. M3-108

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What role do aims play in processor QC?

Processor QC is the daily monitoring of a processor and its chemistry for performance and consistency. Aim values ("aims") for speed, contrast, and base + fog are used to monitor the processing environment.

Small changes in speed (mid density, MD) and contrast (density difference, DD) are expected, as these levels will vary with chemical release during development, changes in film volume, quality of solution, etc. Processor QC will help identify when these levels are out of control. It also identifies trends that require corrective action before control limits are reached and the processor must be shut down.

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Should I retain my developer solution from month to month?

With present Kodak mammography films (such as KODAK Min-R 2000 and Min-R L films) and chemicals (KODAK X-Omat EX II developer or KODAK RP X-Omat developer and KODAK RP X-Omat LO fixer), QC numbers change relatively little from fresh to seasoned developer so it should not be necessary to retain developer for QC stability. In fact, depending on processing conditions over a period of months, retaining the developer may be detrimental to image quality. Image quality is at its best in a well-maintained processor with properly mixed chemistry. Kodak **recommends** changing your developer solution every month or two during scheduled processor cleaning.

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How do I tell if a minus-density artifact is a shadow image or a processor dig?

A simple way to distinguish these types of artifacts is to perform a grease pencil test.

Tools required:

• Film with minus-density artifacts

• Red or yellow grease pencil

• Lint-free wipe (used for screen cleaning)

Procedure:

1. On the emulsion side of the film, use the grease pencil to lightly color in all the minus-density spots of concern. (Note: applying too much pressure will negate the test, as the grease mark will not be able to be wiped off.)
2. Take the wipe and gently clean away the grease pencil marks from all the spots colored.

Analysis:

1. The minus-density spots that are cleaned of grease pencil are shadow images caused by dust or dirt.
2. The minus-density spots that DO NOT clean and remain colored are caused by processor digs.


Figure 1

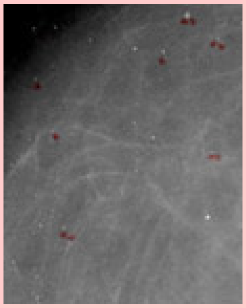
Figure 2

Figure 1 exhibits shadow images caused by dust and dirt.

The grease pencil marks are cleaned off in Figure 2.


Figure 3

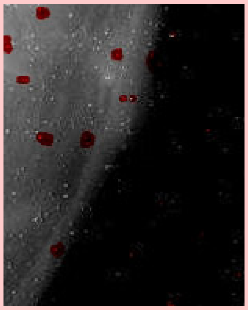
Figure 4

Figure 3 exhibits processor digs.

The grease pencil marks remain in Figure 4.

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What are processor digs?

Sometimes mistakenly referred to as "pick-off," processor digs appear as very small minus-density spots where the emulsion has been removed down to the film base. Often the removed piece of emulsion will be deposited near the trailing edge of the dig, or randomly on the film.

Processor digs are most apparent on single-screen images, and most visible in transmitted light. Unlike shadow images, though, they can also be seen in reflected light.

Causes:

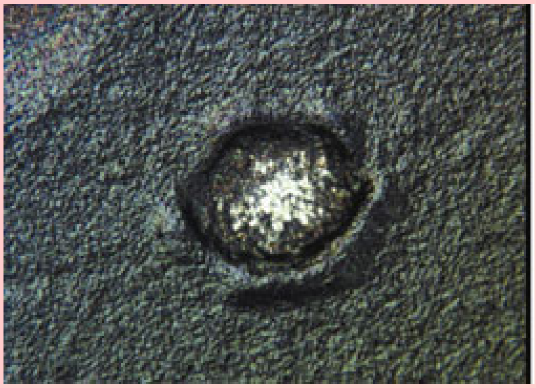
Rough or dirty rollers cause processor digs. Film emulsion is swollen and very soft when in developer or fixer solution. In this state, it is easily displaced if it comes in contact with a roller on which a relatively hard particle is adhered.

Other causes include:

- Inactive/exhausted processing chemicals
- Varying processing transport speed

Remedies:

- Perform the periodic maintenance procedures as outlined in the processor Service Manual.
- Mix new processing solutions.
- Check the surface finish of the knurled rollers for excessively sharp or rough areas. If necessary, install new rollers.
- Check the turnaround and cluster rollers.
- Ensure that the replenishment rates for the developer and fixer solutions are correct for film volume.



A typical processor dig, magnified 140x.

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What steps can improve darkroom hygiene?

The following suggestions can help reduce airborne dust, dirt, and lint from the environment, and make the darkroom easier to keep clean.

- Use an ultraviolet or black light to identify sources of dust and dirt in the darkroom.
  -Note that all dust particles do not fluoresce under ultraviolet illumination.
  -Limit exposure prudently and observe appropriate safety precautions for eyes, face, and exposed skin; do not look directly at the light.
  -Do not expose film to ultraviolet light.
  -Use the light again after cleaning.

Perform daily:

- Damp-mop darkroom floors to remove any dust that settled overnight.
- Clean darkroom countertops using a lint-free wipe and appropriate non-residual cleaner.
- Clean the processor film feed tray last.
  -Moisten a lint-free wipe with a small amount of KODAK MIN-R Screen Cleaner used for intensifying screens.
  -If the feed tray needs to be cleaned more frequently, use the ultraviolet light to check the cleanliness of the incoming air.

Perform occasionally:

- Wipe darkroom walls, cabinet fronts, safelights, vent surfaces, exposed pipes, etc., with a damp lint-free wipe on a weekly basis to eliminate clinging dust.
- Vacuum or use a damp lint-free wipe to remove dirt and dust from the inside of the film bin once a year, or as needed.
- If cassette passboxes are used, check the insides for paint particles, metal flakes, dust, etc.; clean monthly.
- Clean the ID camera.
  -The Model 1 ID camera should be cleaned weekly.

-The counter it sits on should be cleaned daily.

Adjust frequency of occasional cleaning as warranted by the frequency of minus-density artifacts.

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'Tis the season to be dusty…

How can darkroom dust and dirt be reduced? (Part 2)

• Open cases of film (and other corrugated cardboard boxes) outside the darkroom and carry the contents inside to reduce additional cardboard fibers in the darkroom.
• Open new boxes of film slowly and carefully to reduce cardboard fibers from becoming airborne.
• If film is stored in a film bin, remove the flap, stiffener boards, and box top from the darkroom after placing the film (in its envelope and box) in the film bin.
• Remove the stiffener cardboard from film boxes if the film is stored in the box. Do not leave the stiffener boards in the darkroom.
• Use a pair of scissors to cut the film envelope to reduce airborne fibers.
• Do not store loose film in the box, film bin, or film safe at any time.
• Avoid placing unexposed film that has been inside a cassette back into the film supply in the film bin.
• Switch from an identification (ID) printer or camera located in the darkroom to one located outside, or to an ID-capable mammography unit, to eliminate fibers from the thin paper cards inserted into the printer or camera in the darkroom. If using an ID printer or camera, remember to clean it on a regular basis.
• Keep darkroom light-tight.

If cassettes and screens must be cleaned more than once a day and all of the above techniques have been implemented, investigate air changes and venting.

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'Tis the season to be dusty…
How can darkroom dust and dirt be reduced? (Part 1)

Dust and dirt are year-round problems. In the winter months, the situation gets even worse as heating systems circulate accumulated dust and decrease humidity. Following are some of the steps you can take to minimize darkroom dust and dirt.

• Maintain a relative humidity (RH) of between 30 and 50 percent to minimize the attraction of dust and dirt to films and intensifying screens.
• Filter air coming into the darkroom, either at the system level or by placing furnace-type filters in the air vents feeding the darkroom.
• Change air filters according to the manufacturer's frequency recommendations.
• Install electrostatic air-cleaning devices if a significant dust problem exists.
• Locate ventilation louvers in darkroom doors near eye level, not near the floor, and vacuum or wipe periodically.

10 room air exchanges per hour are recommended for a room that is 10 x 10 x 10 feet.

• Use a vacuum cleaner in the darkroom ONLY if the dust particles stirred up from the vacuum exhaust have enough time to settle (e.g., overnight). Then clean the countertops, floors, and film feed tray.
• Thoroughly clean vents on a regular basis.
• Minimize storage in the darkroom.
• Eliminate nonessential items that contribute to dust and paper fiber (newspapers, magazines, facial tissue, notebooks, paper pads, etc.). Avoid hanging or storing articles of clothing in the darkroom. Avoid bringing materials that shed fibers into the darkroom.
• Require all darkroom personnel and technologists to wear lint-free clothing or to wear smocks or lab coats over clothing.
(To be continued.)

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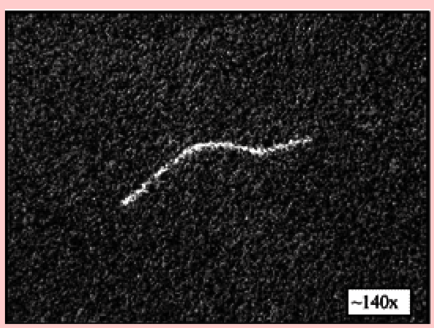
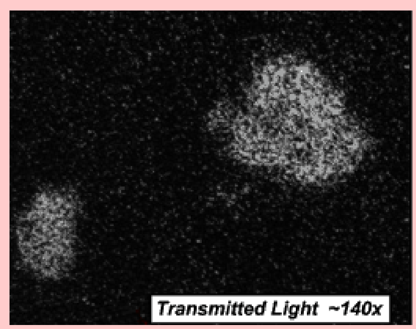
What are shadow images?

Shadow images are caused by dirt and dust superimposed inside the cassette between the intensifying screen and film emulsion. They appear as small, random, minus-density spots on the film, and are frequently confused with pick-off or processor digs. Shadow images account for the majority of minus-density artifacts seen on mammographic images.

Shadow images can be controlled with:
- Proper cleaning of intensifying screen surfaces and cassette interiors
- Periodic cleaning of the interiors of film magazines and roomlight film-handling devices, such as the KODAK Miniloader 2000/2000P
- Proper darkroom cleaning and maintenance



Shadow image caused by a fiber.



Shadow image caused by dust or dirt.

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What is replenishment and why is it necessary?

Replenishment of developer and fixer solutions compensates for the utilization and oxidation of components, as well as solution loss due to evaporation and carryover.

Every time a film is processed, a number of factors contribute to the degradation of the processing solutions:

• Developer is carried over to the fixer, and fixer to the wash tank.
• Bromide, a byproduct of processing, is "seasoned" into the developer solution.
• The pH of both the developer and fixer solutions may change with seasoning, oxidation, ventilation, etc.
• Some of the developer components may be consumed by the development reaction or lose activity over time.
• The silver content of the fixer increases as well as the concentration of halide ions.

Proper replenishment compensates for these changes and facilitates consistent and optimal image quality.

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What are the appropriate replenishment rates for my processor?

Setting the proper replenishment rate is key to achieving optimized image quality and stability, as replenishment helps maintain equilibrium and consistent processor QC.

For Kodak films, chemistry, and processors, the recommended starting points are in **Service Bulletin No. 30**.

- Rates should be established based on the average workload.
- If the workload changes (i.e., the number of films processed increases or decreases), the replenishment rate may need to be revised to reflect this change.
- Film should always be fed in the same way. If rates are set per two 18 x 24-cm films, then two films should always be processed together. If the rate is set per one 18 x 24-cm film, then only one film should be processed at a time.
- The direction of the film feed (e.g., lengthwise or sideways) should always be the same.
- If the optical density of the phantom and clinical image is increased, the replenishment rates may need to be increased.

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What is seasoning?

Seasoning refers to changes in developer and fixer solutions due to the byproducts of film processing. A variety of factors contribute to seasoning, including the chemicals used, replenishment rates, film optical density, and film volume. Studies have shown that 75% of the seasoning change occurs with one tank turnover, 95% with two tank turnovers, and 99% with three. Replenishment "refreshes" the component levels of the developer and fixer, and counteracts seasoning.

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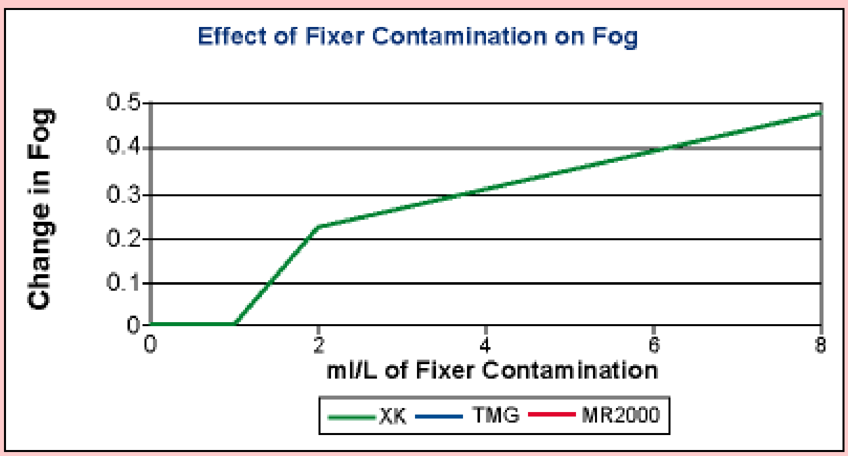
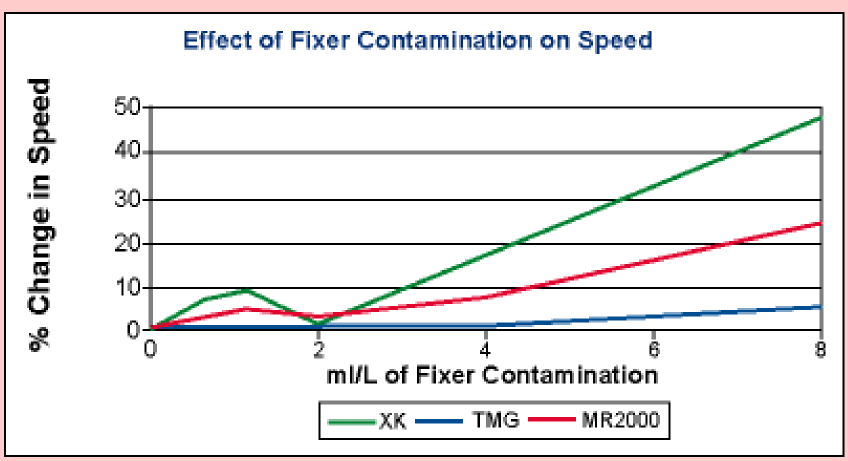
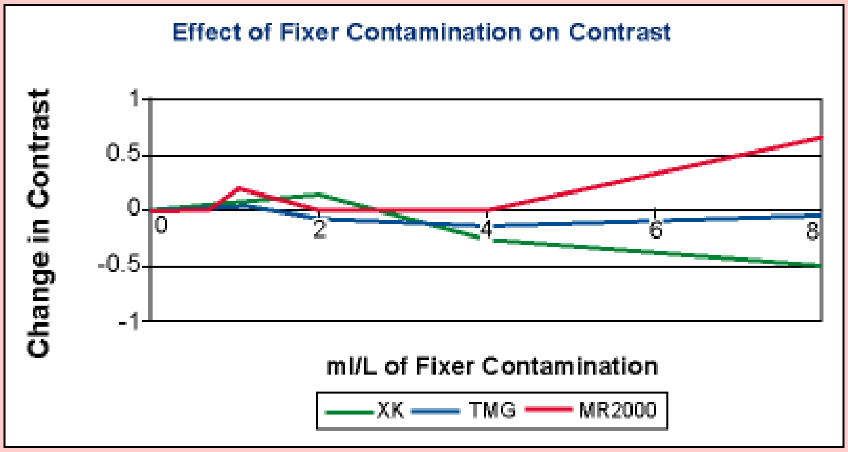
Will fixer contamination of the developer affect my process control and/or clinical images?

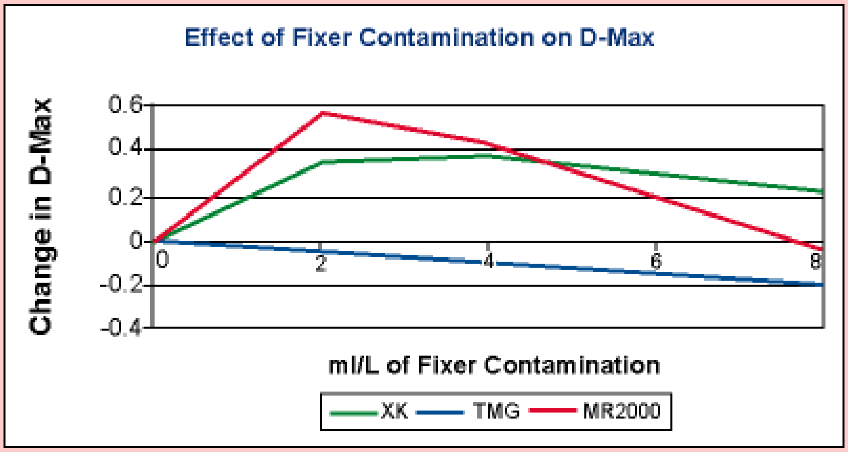
Varying results may occur, depending on the film and fixer type and the level of contamination.

With low-level contamination, some mammography films will exhibit an increase in contrast and D-Max. Some blue-sensitive films, such as KODAK X-OMAT K Film, will react at very low levels of contamination (less than 0.5 ml/L of hypo) by exhibiting an increase in fog and speed. It's a common misconception, however, that fixer contamination increases fog in all films.









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What happens if I don't use a floating lid?

Not using a floating lid will encourage oxidation of the developing agents that may directly affect your process control charts and the clinical image.

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Why should I be concerned about oxidation?

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Oxidation of the developer can affect not only your processor QC numbers but it can also lead to a degradation of clinical image quality on the viewbox. Testing has shown that even with the best developers, image quality will start to degrade within one or two weeks if a floating lid is not used in the replenisher tank by decreasing speed, contrast, D-Max (the maximum density on your clinical image) and image tone.

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How can I prevent premature oxidation of my developer solution?

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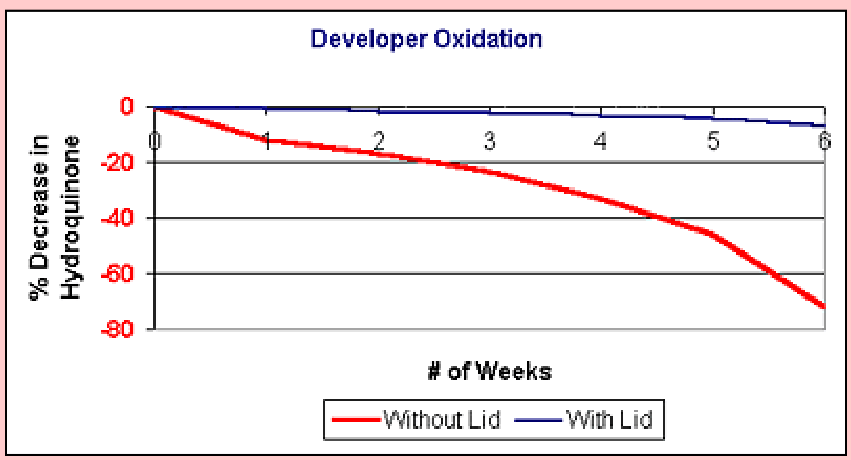
While increasing the developer replenishment rate can partially compensate for oxidation, using a floating lid and properly storing chemicals provides the best means for preventing oxidation. These steps also avoid the added cost and environmental impact of increased replenishment.

The following chart compares the minimal decrease over time of hydroquinone (the primary developing agent in most x-ray film developers) in a tank with a floating lid versus the dramatic decrease in a tank without a floating lid.



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What is developer oxidation?

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The developing agents in a developer solution readily react with oxygen in a process called oxidation. This depletes the developing agents (such as hydroquinone) and reduces the activity of the developer solution.

An antioxidant or preservative helps slow oxidation and maintain development rate. The ratio of preservative to developing agent is therefore critical for effective protection from oxidation.

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How does chemical quality affect film drying?

Chemical quality and adequate replenishment rates are important not only for image quality, but also for proper drying and film transport. Therefore the quality of the developer and fixer, as well as their replenishment rates, should be evaluated and properly adjusted. Also remember that it is important to have your processor ventilation evaluated. Exhausted, oxidized, and/or poor-quality developer and fixer will also affect the hardening of the film, again leading to a marked degradation in drying.

Look for the next tip on June 3rd...In the meantime, we'll be updating our Web site to serve you better, and we apologize for any inconvenience that may result.

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How does dryer venting affect film drying?

Proper processor ventilation is important to achieve proper film drying—and to decrease surface-pattern, or drying, artifacts.

Excessive ventilation results in high evaporation rates and oxidation of the developer. This often seems to correlate with soft shoulder (i.e., skin-line and breast periphery visibility) and non-uniform development issues.

Under-ventilation, on the other hand, tends to result in condensation-related problems and fixer contamination of the developer.

For venting specifications, refer to: **Service Bulletin No. 101** (October 1992), Dryer Venting Requirements for All KODAK X-OMAT Processors, Publication No. N-923.

Look for the next tip on June 3rd...In the meantime, we'll be updating our Web site to serve you better, and we apologize for any inconvenience that may result.

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What is the correct dryer temperature for optimal results?

Set your dryer temperature as low as possible while still producing good drying. In addition to yielding energy savings, this will limit the possibility of film artifacts produced by over-drying.

Dryer temperature should never exceed the film manufacturer's recommendations. Raising the temperature beyond this limit—for example, in response to tacky films exiting the processor—can have a negative impact on image quality. Over-dried films usually exhibit severe artifacts visible with transmitted light (i.e., through the film) as well as reflected light (i.e., on the film surface).

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What factors affect film drying?

Drying is the very last step in mammography film processing. How well film dries depends upon a number of factors, including:

- Processor design
- Venting
- Temperature
- Humidity
- Quality of chemistry
- Film volume (i.e., serial unload, batch processing)
- **Wash-water temperature**

Note: Future Tech Tips will explore many of these factors.

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Does water temperature affect processing solutions?

Whether mixing by hand or with an automated mixer, water temperature plays a key role.

Too low or too high a temperature may result in premature oxidation of the developer. It may also affect image quality, processor control stability, and image tone.

It is important to follow the chemical manufacturer's recommendations for water temperature. Kodak recommends mixing with water at a temperature between 70° and 80° F (21.1° and 26.7° C).

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Does water quality matter when mixing developer or fixer?

Water is the one ingredient in a processing solution supplied by the customer. Because the quality of that water can be a factor in the variability of a developer or fixer, the water used should be relatively pure.

While processing solutions should contain some sequestering agents for metals, if the water has a high metal content those solutions will not be totally effective. Water may also contain other impurities or biological growth that cause processing problems. Heavy metals, for example, can lead to developer oxidation. Other ions, such as calcium, can form insoluble hydroxide compounds at the alkaline pH levels that are present in a developer solution.

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What effect does fixer have on dye stain?

In some processing situations, mammography film may exhibit dye stain, recognized by a general pinkish or lavender tint in a D-min area of the film. The incidence of dye stain is only one reason why it's just as important to follow the film manufacturer's recommendations for fixer—in terms of type, replenishment rate, etc.—as it is for developer.

The increasing prevalence of fixer reuse and systematic replenishment rate reduction to minimize costs and environmental impact make this even more imperative. In addition, mammography films may be more difficult to clear and image stability storage requirements are longer.

Dye stain may be more pronounced in the following situations:
- A combination of electrolytic silver recovery with reduced fixer replenishment rates.
- The use of fixers exhibiting a high pH and/or high hardener level. (Note: It is normal for the pH to increase with seasoning; increasing the fixer replenishment rate may help control the pH.)

It may be possible to reduce dye stain by:
- Checking that the fixer has been properly mixed.
- Increasing the fixer replenishment rate.
- Verifying that the film is being processed in the appropriate cycle.
- Checking the temperature of the fixer solution in the processor, and increasing to approximately 5° F (3° C) above the developer temperature, if possible.
- Checking the temperature of the wash water in the processor and increasing it, if possible. **(Refer to Service Bulletin No. 30 , revised September 2001, for general processor information.)**

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What effect does fixer have on image tone?

Image tone is a measure of both the blue Estar base and the silver image in a radiograph. The image will be very blue at low densities and less blue (brown) at high densities, creating an overall perception of image tone.

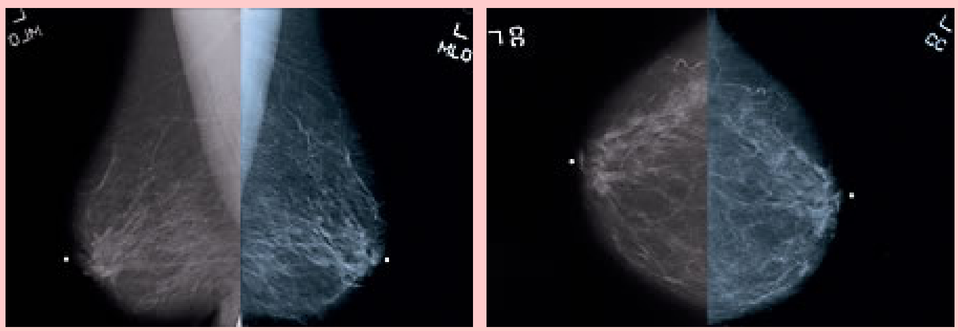
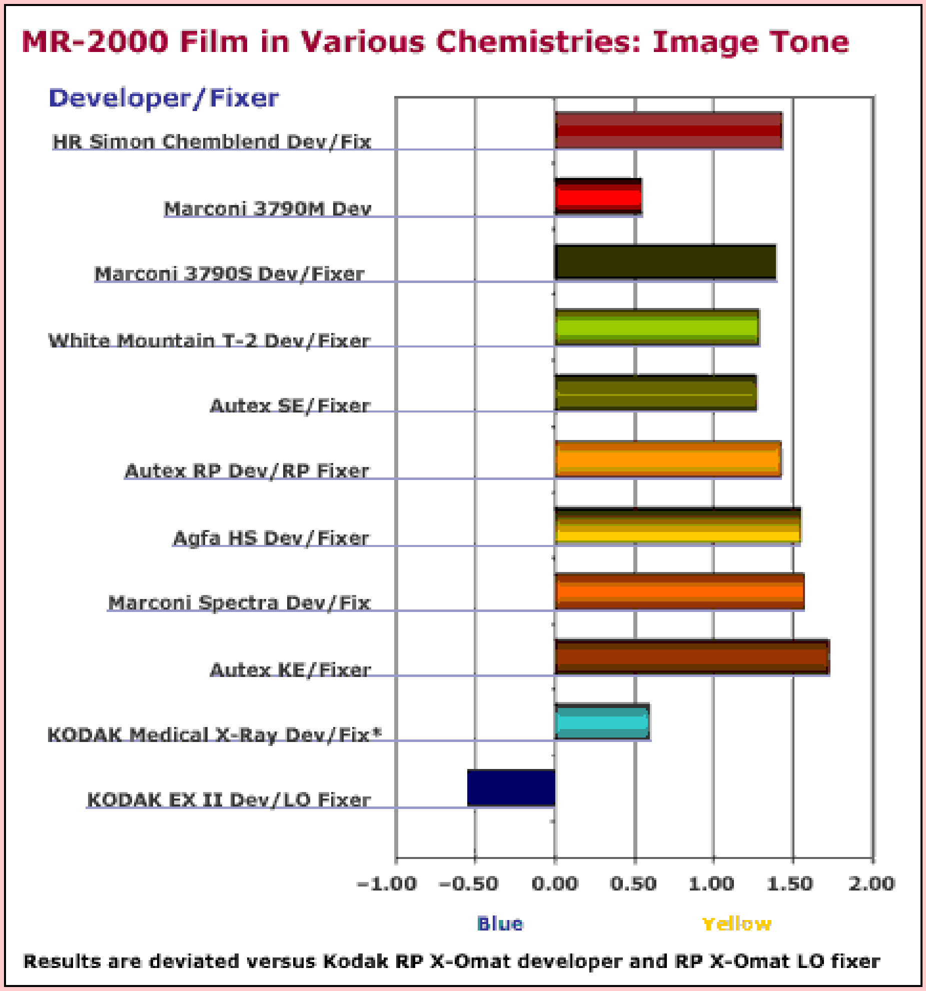


Image tone of Kodak Min-R 2000 film with different chemistries. Images courtesy of the Diagnostic Imaging Center, Auburn, NY .

For some films, this can be affected by components in the developer and fixer. Kodak high-tier developers and fixers, for example, are formulated to give a "colder" (more blue) image tone with Kodak films. The result is excellent visualization of detail and viewing ease.



*Kodak does not recommend the use of Kodak medical x-ray developer with Kodak mammography film.

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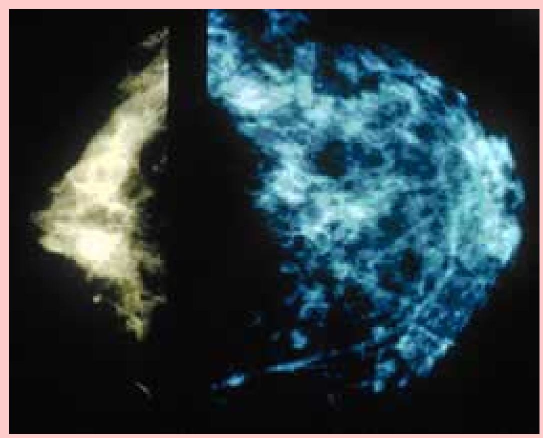
Why is fixer important?

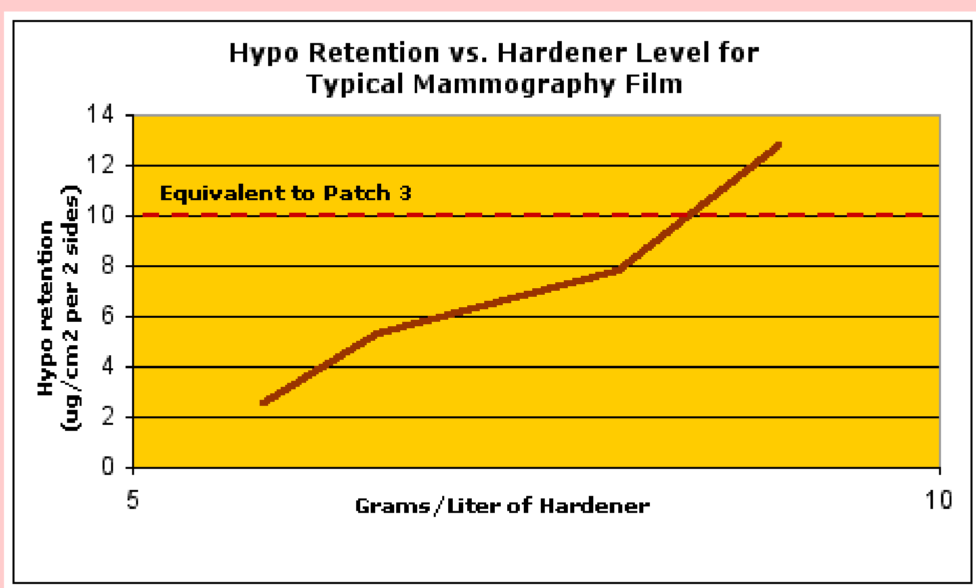
Fixer is often thought to be interchangeable but it plays a vital role in the photographic process. Of particular importance is its impact on the archivability, image tone, dye stain, and drying of clinical films.



Hypo retention is a significant concern with many films, particularly those that need to be stored for long-term viewing of greater than 20 years such as mammography and dental films.

If not adequately washed, an emulsion can retain thiosulfate (hypo) from the fixer. As the residual hypo decomposes over time, the resulting sulfur adds density to the film or destroys the silver image, often leading to yellowing.

Inadequate washing can result from the use of fixer with a very low pH which restricts the film swell, as well as fixer with a high level of hardener for enhanced transport in processors with small, weak dryers.



Unfortunately, the effects of hypo retention may not be noticed for many years, so periodic testing of fixer is important. The ACR and MQSA require quarterly testing, as detailed in the **KODAK MIN-R 2000 Optimization Guide**.

KODAK RP X-OMAT LO Fixer was formulated considering the effect on hypo retention, dye stain, and drying when processing Kodak films.

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Why isn't a specific gravity measurement enough to check the integrity of processing chemistry?

While specific gravity—measured as the relative weight of a processing solution as compared with the density of water at 39.2° F (4° C)—can indicate over- or under-dilution, by itself it does not verify solution content. For example, a specific gravity test cannot determine whether critical components such as developer antifoggants are missing or have been depleted.

For demonstrating proper dilution, specific gravity tests can be done using hydrometers that can be purchased at a reasonable price. Measurements must be taken at the temperature at which the hydrometer was calibrated.

Following are recommended pH levels for Kodak developers and fixers at 77° F (25° C):

Recommended for Mammography	
K ODAK X-O MAT EX II Developer and Replenisher (10 gallons)	10.40 to 10.50
K ODAK RP X-O MAT Developer and Replenisher (10, 20, 200 gallons)	10.22 to 10.38
K ODAK RP X-O MAT Developer and Replenisher, MX-1275 (400 gallons)	10.22 to 10.38
K ODAK RP X-O MAT LO Fixer and Replenisher	4.25 to 4.45

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How can I tell if my processing solutions will adequately develop KODAK Mammography Films?

The following recommended procedure can be used to determine if another manufacturer's developer is within Kodak's acceptable range for KODAK Mammography Films. You will need to have access to a processor using fresh KODAK RP X-OMAT Developer and Replenisher, or KODAK X-OMAT EX II Developer and Replenisher with the appropriate amount of KODAK RP X-OMAT Developer Starter, for the type of film to be tested.

NOTE: This procedure will take from 2 to 4 hours to perform. Do not attempt to perform this test unless both developers will be tested within that time frame on the same day. Ideally, this test should be performed using components of the complete KODAK Mammography System (i.e., processors and cassettes).

Items Needed

- A calibrated sensitometer/densitometer that accurately reads above 4.0 O.D. (optical density)
- Calibrated digital thermometer
- Stopwatch
- KODAK MIN-R 2000 or MIN-R L Film
- Freshly mixed KODAK RP X-OMAT Developer and Replenisher, or KODAK X-OMAT EX II Developer and Replenisher and a bottle of KODAK RP X-OMAT Developer Starter
- Freshly mixed other manufacturer's developer and replenisher and a bottle of the other manufacturer's starter

Setup, Exposure, and Processing

Information to complete steps 1–4 can be found in **Service Bulletin No. 30** (revised September 2001), available by calling the Health FAXBACK System at 1-800-336-4722, Option 4.

1. Fill the processor with KODAK RP X-OMAT Developer or KODAK X-OMAT EX II Developer and Replenisher, adding Kodak's recommended amount of starter for the mammography film to be used.
2. Using the calibrated thermometer, verify that the developer temperature is set as per Kodak recommendations.
3. Set the developer and fixer replenishment rates to Kodak's recommendations for processor type and film.
4. Measure the drop time for an 18 x 24-cm film and verify that the transport speed is set accurately. If it is not, adjust the transport time or abort the test and call service.
5. Set the sensitometer for green sensitivity. Be sure that the emulsion side faces the light-exposing source (emulsion side for Min-R 2000 and primary emulsion for Min-R L).
6. Expose three films.
7. Process the film on the right-hand side of the feed tray, primary emulsion side down.

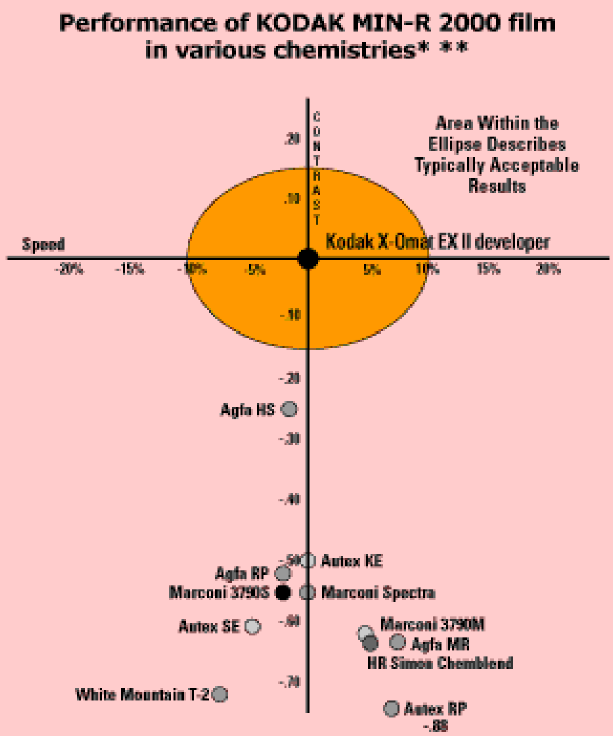
8. Label all films. Indicate developer used, date, time, and any other relevant information (chemistry replenishment rates, etc.).
9. Drain the developer solution, change the developer filter, and thoroughly rinse the tank, rack, and developer-to-fixer crossover assembly. Repeat steps 1–8 using the other manufacturer's developer. Use the developer manufacturer's recommended starter and replenishment volumes.

Evaluation

1. Read the films using the calibrated scanning densitometer. If using a spot-reading densitometer, it will be necessary to plot the curve. Note the speed value (step closest to 1.0 above gross fog) and the **average gradient**.
2. Average the speed and average gradient for the three films processed through KODAK Developer. Repeat for the films processed through the other manufacturer's developer.
3. Compare the speed and average gradient for the films processed in the other manufacturer's chemistry to that in KODAK RP X-OMAT Developer and Replenisher or KODAK X-OMAT EX II Developer and Replenisher. Typically acceptable results are within the ellipse shown in Figure 1. This ellipse is defined by:
   - a maximum range of ±10% in optical density at the speed step
   - ±0.15 for average gradient of the films processed through KODAK Developer

   To verify adequate developing, the optical density of the 21st step should be measured. If the optical density is lower than 4.0 (for KODAK MIN-R 2000 Film with KODAK RP X-OMAT Developer), the test should be declared invalid. Other factors could affect the validity of the test. Please consult Kodak if you have questions.

Figure 1.



*Results based on fresh chemistry.
(Actual sensitometric results may vary with seasoning.)

**Each developer was tested with the manufacturer's recommended fixer and recommended starter volume. All were processed in a KODAK X-OMAT RA film processor.

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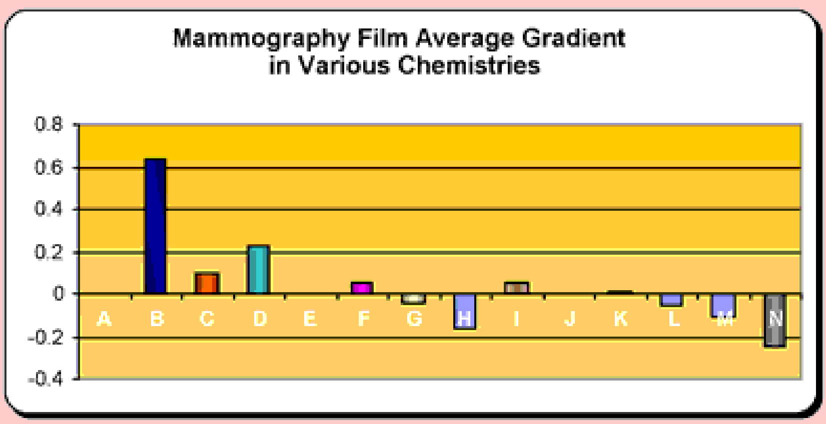
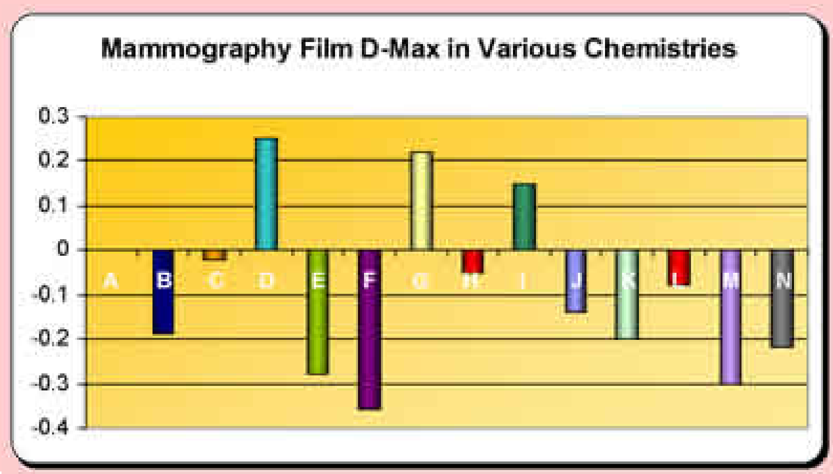
How do different chemistries affect a clinical image?

The choice of chemistry (developer and fixer) impacts not only the contrast (average gradient), dose (speed) and D-Max (darkest area) of the clinical image but also the color (image tone and dye stain). So the chemistry you use can have a real impact on the clinical image.

For mammography film, the type of developer used can change the average gradient by 0.8 and the D-Max by 0.5. While some developers may increase average gradient, other sensitometric characteristics such as D-Max and speed may be adversely affected. The resulting clinical images may be unacceptable to radiologists, and diagnostic confidence compromised.





"A" is KODAK RP X-OMAT Developer and KODAK RP X-OMAT LO Fixer and Replenisher. The other chemistries are deviated versus this combination.

- The United States Food and Drug Administration (FDA) Mammography Quality Standards Act (MQSA) Final Regulations became effective April 28, 1999. The regulations require documentation on processing chemicals used in mammography:
  -21 CFR 900.12 (b)(13) For processing mammography films, the facility shall use chemical solutions that are capable of developing the films used by the facility in a manner equivalent to the minimum requirements specified by the film manufacturer.

- The FDA offers the following guidance in clarification of these rules:
  -the "facility must either have documentation from the chemical manufacturer/ supplier or the film manufacturer showing that the processing chemicals being used provide results consistent with the film manufacturer's processing specifications, or the facility must establish that the film performance is sensitometrically equivalent to films developed according to the film manufacturers specific recommendations."

Eastman Kodak Company recommends the use of KODAK RP X-OMAT Developer and Replenisher, KODAK X-OMAT EX II Developer and Replenisher, KODAK RP X-OMAT LO Fixer and Replenisher and KODAK RP X-OMAT Developer Starter, for optimal results with KODAK Mammography films. It is important to follow Kodak's mixing and processing recommendations.

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Why is adding variable amounts of starter to adjust film speed and contrast not recommended?

It can mask quality-control problems, and even add to them.

Varying the amount of starter in an effort to stay within process-control limits defeats the purpose of doing daily QC. Eventually, the bromide level in the processor will either revert to its previous level or reach a new equilibrium. Either way, the QC values may go out of control again.

Instead of manipulating the starter level, it's better to find the root of the problem and take corrective action.

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What will happen if I under-use or overuse starter?

It depends on the type of film.

For Kodak Min-R 2000 and Min-R L films, the under-use or lack-of-use of starter generally results in an increase in speed and D-max. Decreases in contrast on the H&D curve as well as the clinical image also result. Adding too much starter may change the speed, contrast, and D-max as well.

For general films, not using starter or grossly over-replenishing will result in an increase in base + fog and speed, and a decrease in contrast.

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How much starter should I use?

Different films have varying seasoning effects in combination with different developers and processors. So there is no one set amount of starter to be used in balancing the chemical and sensitometric conditions of fresh replenisher and seasoned tank solutions.

Kodak tests its films, chemicals, and processors to determine seasoning effects and starter needs. Recommendations for Kodak films, processors and chemistry may be found in Processing Recommendations for KODAK films in KODAK X-OMAT Processors **(Service Bulletin No. 30)**. It also provides specific starter recommendations. It is available via faxback at 1-800-336-4722, option 3.

For best results, be sure to follow your manufacturer's recommendations and use the proper amount of starter with all developers.

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Why is starter important?

Starter helps maintain developer balance and processing consistency.

Halide ions from exposed film, such as bromide, "season" into developer during processing. Adding fresh developer dilutes the concentration of these halide ions. This alteration in the chemical makeup of the seasoned developer can lead to changes in the fog, speed, and contrast of processed film.

The use of starter adds halide ions to the solution, minimizing the chemical and sensitometric differences between fresh replenisher and seasoned tank solutions. More consistent processing conditions result.

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What is the recommended processing cycle for KODAK MIN-R EV Film?

KODAK MIN-R EV Film may be processed in either the standard or rapid cycle.
Note that with rapid cycle, hardened developers such as KODAK X-OMAT EX II or KODAK RP X-OMAT MUST be used. KODAK RP X-OMAT LO Fixer and Replenisher must be used for standard and rapid cycle.

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