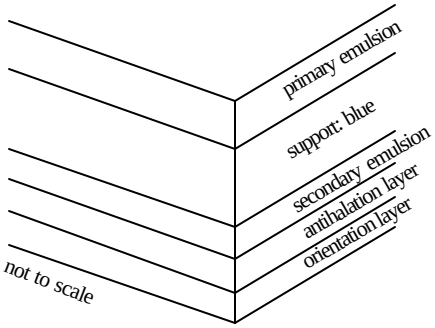
KODAK MIN-R EV Mammography Film Conversion Guide

- MIN-R EV has a novel double emulsion design, for use with standard, green-emitting single screen cassettes.
- MIN-R EV is identified by a spaced double V-notch. The primary emulsion is up when the notch is on the right hand side at the top edge of the film. The primary emulsion must be in contact with the screen during imaging.
- Kodak has added an orientation layer to the film to aid in the identification of the primary emulsion side; the dull side identifies the primary emulsion side of the film (the side which is to be placed against the screen during imaging).
- KODAK MIN-R EV Film is designed for optimal results in standard cycle processing
  - The film may be processed in Rapid cycle when used with KODAK X-OMAT EX II or KODAK RP X-OMAT Developer and KODAK RP X-OMAT LO Fixer.

- In documentation that refers to the emulsion side of the film, this should be considered a reference to the primary emulsion of MIN-R EV film.




Not to scale

OBJECTIVES OF THE CONVERSION GUIDE

- Establish/verify correct processing parameters for KODAK MIN-R EV Film
- Establish quality control aims
- Establish initial image quality parameters
- Verify other Quality Control tests

Tools Required:

- Sensitometer capable of producing 21 steps
- Densitometer capable of spot reading greater than optical density of 4.5
- Thermometer
- Curve plotting paper (KODAK Publication # M3-58, Cat # 841 2843) or scanning densitometer
- 4-5 cm Lucite or BR 12 tissue equivalent phantom (RMI 156, Nuclear Associates 18-220)

Reference Material:

- **KODAK MIN-R EV Film System User Guide** (KODAK Publication #, Cat #)
- *MIN-R EV Film Demonstration Guidelines*
- *MIN-R EV Film Q&A Guide*
- *Service Bulletin No. 30*, revised 2003
- Mammography Quality Control Manual 1999, American College of Radiology

0. Before you begin

Benchmark the facility using the mammography benchmarking form.

- Compare sensitometry (current film versus MIN-R EV)
- Compare accreditation phantom (current film versus MIN-R EV)

o **Perform the optical density and kVp series with MIN-R EV**

1. Processors

KODAK MIN-R EV Film is designed for optimal results in standard cycle processing. All KODAK X-OMAT Processors should be adjusted to comply with the standard cycle processing parameters listed in the film processing instructions for that specific processor. If using KODAK X-OMAT EX II or KODAK RP X-OMAT Developer and KODAK RP X-OMAT LO Fixer, the film may be processed in the Rapid cycle. If using the rapid cycle, all KODAK X-OMAT Processors should be adjusted to comply with the rapid cycle processing parameters listed in the film processing instructions for that specific processor.

KODAK MIN-R EV Film should be processed **primary emulsion side down** in the KODAK MIN-R Mammography and KODAK X-OMAT M35A-M / M35-M processors. Best results will be obtained using the KODAK MIN-R Mammography processor.

Processor	Process Min-R EV Primary Emulsion Up/Down
Min-R Mammography, M35A-M, M35M	Down
3000 RA, 270 RA, M7 series	Up
M6 B, M6R, 5000 RA, 480 RA, 460 RA	Up

Note**: The KODAK Medical X-Ray, X-OMAT M43, M43A, Clinic 1, X-OMAT 1000, M35A, M35 and X-OMAT 2000 and 2000 A Processors are not recommended for processing KODAK MIN-R EV Film (or other KODAK Mammography Films). Other manufacturers' processors with shallow developer tanks or short developer racks may not produce optimum results if used to process KODAK MIN-R EV Film. Consult the processor manufacturer recommendations for standard/rapid cycle processing set-up.**

2. Chemicals

- Drain, clean, and refill the Developer and Fixer Tanks.
- If using an automated specific gravity based mixer and converting to KODAK X-OMAT EX II Developer and Replenisher (or KODAK RP X-OMAT Developer and Replenisher) and KODAK RP X-OMAT LO Fixer and Replenisher, ensure that the specific gravity is set as follows:

Processing Chemistry	Specific Gravity Range*
KODAK X-OMAT EX II Developer and Replenisher	1.070 to 1.080
KODAK RP X-OMAT Developer and Replenisher	1.081 to 1.091
KODAK RP X-OMAT LO Fixer and Replenisher	1.080 to 1.100

*Specific Gravity measured at 77º F.

- **KODAK MIN-R EV Film requires 25 ml/l (3 fluid ounces per gallon) of KODAK RP X-OMAT Developer Starter.** See the attached General Processor Information for recommended starter volumes for a specific KODAK processor.

Optimum results are obtained using KODAK X-OMAT EX II and RP X-OMAT Developer Replenishers. Kodak does **not** recommend the use of KODAK Medical X-ray Developer Replenisher with KODAK MIN-R EV Film. The United States Food and Drug Administration (FDA) Mammography Quality Standards Act (MQSA) Final Regulations, effective April 28, 1999, states that processing solutions be capable of developing films in a manner equivalent to the minimum requirements specified by the film manufacturer. To determine if another manufacturer's developer is within Kodak's acceptable range for KODAK MIN-R EV Film, please refer to the

KODAK MIN-R EV Film System Mammography User Guide. If attempting to use another manufacturer's developer, contact the developer manufacturer for recommended replenishment rates.

Optimum results are obtained using KODAK RP X-OMAT LO Fixer and Replenisher.

For best results, processing solutions should be mixed with 70°F to 80°F (21.1°C to 26.6°C) water.

> **Warning:** KODAK Medical X-ray Developer and Replenisher is **not recommended** for KODAK Mammography Film. KODAK Medical X-ray Fixer is not optimized for KODAK Mammography Film.

3. Adjust the Developer and Fixer Replenishment Rates.

Dedicated Processing: KODAK MIN-R EV Film requires specific replenishment rates for developer and fixer. These recommendations are guidelines for KODAK X-OMAT EX II Developer and Replenisher, KODAK RP X-OMAT Developer and Replenisher and KODAK RP X-OMAT LO Fixer and Replenisher. Developer and fixer replenishment rates may require adjustment for specific processing environments.

If attempting to use other manufacturer's developers and fixers, contact the manufacturer for recommended replenishment rates.

Recommended Replenishment Rates
Dedicated Mammography

A processor is considered dedicated if only mammography or single-emulsion film such as ultrasound is processed.
General purpose (non-dedicated) processors should use the replenishment rates listed for general radiography.

Note: These guidelines should be used as initial starting points only. If adjustments are made from these it is recommended that only 10% change be made at any one time.

For Area Processors with Smart Replenishment

- KODAK X-OMAT Processor Models 270 RA, 3000 RA, M6RA, 460 RA, 480 RA, 5000 RA
- KODAK X-OMAT Multiloader 7000, KODAK X-OMAT Multiloader 300/300 Plus

  - Smart Replenishment is enabled by default. **It is recommended that smart replenishment be disabled for Min-R EV film. Consult service.**
  - The equivalent area of a 35 x 43 cm (14 x 17 in.) film is 1505 cm sq. (238 sq. in.).
  - Replenishment takes place after the equivalent area of a 35 x 43 cm (14 x 17 in.) film has been fed; therefore, replenishment rates must be set for a 35 x 43 cm (14 x 17 in.) film feed.
  - Additional replenishment occurs automatically during low film usage. This feature can be overridden by using software version 3.0 or higher. **Note:** X-OMAT 3000 RA and X-OMAT 5000 RA Processors have the ability to override this feature without installing new software.

Film Processed	Use Condition	Average Number of Films per 8 hrs Of Processor Operation	Replenishment Rates* (ml per 35 x 43 cm)	
			Developer	Fixer
MIN-R EV	Smart Replenishment disabled (recommended)	60 sheets or more	90	105
		Less than 60 sheets	Flooded	Flooded
MIN-R EV	Smart Replenishment enabled	260 sheets or more	90	105
		200 sheets	80	
		150 sheets	70	
		100 sheets	65	
		70 sheets	60	
		Less than 60 sheets	Flooded	Flooded
* Flooded replenishment is available if needed to maintain sensitometry for very low use conditions.				

Smart replenishment should be turned off (refer to Service Bulletin No. 30)

For Length Processors

- KODAK X-OMAT Processor Models M35-M, M35A-M, M7B, M7B-E, M6A-N, M6AW, M6B, M6R
- KODAK MIN-R Mammography Processor

- Replenishment takes place whenever film is in the entrance rollers.
- Replenishment rates must be set according to usage and film size(s) fed.
- MIN-R EV Film is fed **primary emulsion side down** in M35-M, M35A-M, and MIN-R Mammography Processors.
- For the KODAK Multiloader 700 docked to length replenished processors, mammography rates are set using 18 cm film travel.

Film Processed	Film Feeding	Use Condition	Average Number of Films per 8 hrs Of Processor Operation	Replenishment Rates (ml per 18 x 24 cm)**	
				Developer	Fixer
MIN-R EV	Single	Medium - High	60 sheets or more	25	30
		Low	60 sheets or less*	Flooded	Flooded
	Double	Medium - High	60 sheets or more	50	60
		Low	60 sheets or less *	Flooded	Flooded
* If flooded replenishment is not used, sensitometry may not stay within control limits. ** Use a single 18 x 24 cm film to set the replenishment rates listed.					

Recommended Replenishment Rates Non-Dedicated Mammography

Non-Dedicated Processing: KODAK MIN-R EV Film can be processed with most current traditional medical x-ray film. Kodak does not recommend processing Helium Neon and IR films with KODAK MIN-R EV Film. Use 25 ml/l (3 fl oz per gallon) of KODAK RP X-OMAT Developer Starter for non-dedicated processing environments. KODAK MIN-R EV Film requires specific replenishment rates for developer and fixer. These recommendations are guidelines for KODAK X-OMAT EX II Developer and Replenisher, KODAK RP X-OMAT Developer and Replenisher, and KODAK RP X-OMAT LO Fixer and Replenisher. Developer and fixer replenishment rates may require adjustment for specific processing environments. If attempting to use other manufacturers' developers and fixers, contact the manufacturer for recommended replenishment rates.

For Area Processors with Smart Replenishment

- KODAK X-OMAT Processor Models 270 RA, 3000 RA, M6RA, 460 RA, 480 RA, 5000 RA
- KODAK X-OMAT Multiloader 7000, KODAK X-OMAT Multiloader 300/300 Plus

- Smart Replenishment is enabled by default.
- Replenishment takes place after the equivalent area of a 35 x 43 cm (14 x 17 in.) film has been fed; therefore, replenishment rates must be set for a 35 x 43 cm (14 x 17 in.) film feed.
- Additional replenishment occurs automatically during low film usage.

Film Size Processed	Use Condition	Average Amount of 35 x 43 cm Equivalent Films per 8 hrs of Processor Operation	Replenishment Rates (ml per 35 x 43 cm)	
			Developer	Fixer
All	Any	Any number *	60	85
* Flooded replenishment should not be needed due to the automatic compensation for use, but it is available if needed to maintain sensitometry for very low use conditions (fewer than the equivalent of 25 35x43 cm films).				

For Length Processors

- KODAK X-OMAT Processor Models M35-M, M35A-M, M7B, M7B-E, M6A-N, M6AW, M6B, M6R
- KODAK MIN-R Mammography Processor

- Replenishment takes place whenever film is in the entrance rollers.
- Replenishment rates must be set according to usage and film size(s) fed.
- Film should be fed as recommended in the processor Operator Manual/User Guide.

. Processor	Process Min-R EV Primary Emulsion Up/Down
Min-R Mammography, M35A-M, M35M	Down
3000 RA, 270 RA, M7 series	Up
M6 B, M6R, 5000 RA, 480 RA, 460 RA	Up

- X-OMAT M35M, M35A-M and MIN-R Mammography Processors are *not recommended* for roll film

Film Size Processed	Use Condition	Average Number of Films per 8 hrs Of Processor Operation	Replenishment Rates (ml per 35 x 43 cm)	
			Developer	Fixer
Average size intermix	High	115 sheets or more	50	70
	Medium	40 - 115 sheets	65	85
	Low	40 sheets or less *	80	100
* If flooded replenishment is not used, sensitometry may not stay within control limits.				

Flooded Replenishment: Flooded replenishment can be used to help maintain stable processor quality control with low volume processing. **For KODAK MIN-R EV Film, it requires 25 ml/l (3 fl oz per gallon) of KODAK RP X-OMAT Developer Starter in the external developer replenishment tank.**

Flooded Replenishment Rate Recommendations

- For low use rates, if sensitometry does not stay within control limits, flooded replenishment may be needed to maintain the developer solution at a continuously fresh chemical activity. This is accomplished by replenishing not only when film is fed or area accumulated, but also

on the basis of additional replenishment added during the processor on time with an automatic replenishment timing system.

- When in the flooded mode, developer starter is added to the replenishment tanks at a rate of 89 ml per gallon or 25 ml per liter (3 fl oz per gallon) for MIN-R EV film.
- For detailed information on how to set up each processor for flooded replenishment, see the appropriate service publication for that processor.
- Qualified service personnel should do the processor setup.
- When filling the developer replenishment or processor tank, add starter according to the table below.

KODAK Developer	Flooded Mode	Add Starter?	
		Replenishment Tank	Processor Tank
X-OMAT EX II	No	No	Yes
	Yes	Yes	No*
RP X-OMAT	No	No	Yes
	Yes	Yes	No*
* Fill the processor tank with chemistry that was mixed in the replenishment tank.			

4. Dryer

Dedicated processors converted to Min-R EV film may be able to reduce the dryer temperature. An uneven density pattern may be noted if the dryer temperature is too high. Please refer to Section 7.

- Set the Dryer temperature to the minimum required to produce dry film. Tacky or wet films occurring even with adjusted Dryer temperatures may indicate that additional service is required.
- Check that the Dryer Air Tubes are in the correct positions. Remove any dirt from the Dryer Rollers and Air Tubes, especially the slots.
- Check the settings for correct replenishment.
- Check the replenishment system for kinks in the Tubing, the operation of the Recirculation and Replenishment Pumps, and the Detector Switches. Change any chemicals that were not mixed correctly, are exhausted, or are contaminated.
- Check that the Dryer air exhaust is free from any obstructions and is installed correctly according to the specifications in the installation instructions.
- You may be able to decrease the dryer temperature.
- Should uneven density be noticed, refer to Section 7, evaluating the Imaging Chain for Uniformity.

General Processor Information

NC = Not Controlled (temperature)
NR = Process Not Recommended for this film type

Processor Model	Cycle	Approx Devl Tank Volume	Starter Volume	Temperature			Transport Speed	Capacity 35 x 43 cm (18 x 24 cm)	Approx Devl Time	Approx Drop Time** 35cm length (24cm length)
			MIN-R EV	Dev	Fixer*	Water				
		gal (L)	fl oz (ml)	°F (°C)	°F (°C)	°F (°C)	in./min (cm/min)	films/hr	seconds	seconds
M35-M M35A-M	S	2.25 (8.3)	6.5 (190)	92° F (33.3° C)	NC	40° - 85° F (4° - 29.4° C)	30 (76.2)	94 (145)	33	150 (135)
MIN-R Mammo	S	2.25 (8.3)	6.5 (190)	92° F (33.3° C)	NC	40° - 85° F (4° - 29.4° C)	30 (76.2)	(145)	33	150 (135)
	R			94°F (34.4° C)					25	112 (101)
M7B M7B-E	S	2.25 (8.3)	6.5 (190)	94° F (34.4° C)	NC	40° - 85° F (4° - 29.4° C)	42 (106.7)	146 (250)	27	120 (116)
3000 RA 270 RA XML300 XML300+ XML7000	S	2.25 (8.3)	6.5 (190)	94° F (34.4° C)	90° F (32° C)	40° - 85° F (4° - 29.4° C)	42 (106.7)	148 (250)	26	111 (104)
	R			99° F 37.2° C	95° F (35° C)		57 (144.8)	201	19	82
M6A-N M6AW M6B M6R	S	2.8 (10.7)	Molded: 8.5 (250) Stainless: 8 (237)	95° F (35° C)	NC	M6A-N: 85° - 90° F (30°-32.2°C) M6AW, M6B: 40° - 90° F (4° - 32.2° C)	66 (167.6)	229 (393)	25	90 (86)
M6RA 460 RA 480 RA 5000 RA	S	2.8 (10.7)	8.5 (250)	95° F (35° C)	95° F (35° C)	40° - 85° F (4° - 29.4° C)	66 (167.6)	233 (393)	24	95 (89)
	R			101° F (38.3° C)			99 (251.5)	351	16	60

* Fixer temperature may exceed value listed due to internal ambient temperatures in the processor.
** Drop Time is defined as the time from the Lead Edge In (LEI) to the Trail Edge Out (TEO) for a 35 x 43 cm film. (Represents 18 x 24 cm LEI/TEO)

5. Processor Quality Control Operating Levels

The following instructions are recommendations for the control of the processor quality. Different sensitometric parameters will be monitored (MD: mid-density/speed, DD: density difference/contrast, B+F: base+fog/gross fog). You can modify these different parameters based on local regulations or guidelines.

Processor Control Aims

a. Using a Sensitometer, expose and process a Sensitometric strip. Repeat this exposure and processing once each day for **five consecutive days**. For large volume processing tanks or very low film volume a 10 day average may be used. For the KODAK Process Control Sensitometer and X-rite models 394 and 396, the following Dip Switch settings are recommended for KODAK MIN-R EV Film:
   - SINGLE and GREEN settings at Exposure Setting No. 4
   - 1-down, 2-down, 3-up, 4-down

- Using a lower exposure setting will decrease the optical density, using a higher exposure setting will increase the optical density.

For other manufacturers, follow the recommendations for optimum mammographic results (optimized green, single emulsion).

b. Read and record the densities of each step of the sensitometric strip using the densitometer, including an area of processed film that has not been exposed.
c. From the five strips, determine the average of the densities for each step using the respective densities for each step.
d. Determine which step has an average density closest to 1.20 but above 1.0. Designate this step as the mid-density (MD)/speed step. Tolerance +/- 0.10-0.15
e. Determine which step has a density closest to 2.20 and which step has a density closest to but not less than 0.45. The difference in densities between these two steps should be designated as the density difference (DD)/contrast. Tolerance +/- 0.10-0.15
f. Determine the average of the densities from the unexposed area of the five strips. This density will be designated as the base-plus-fog level (B+F)/gross fog of the film. Tolerance < 0.25
g. Start a new Processor quality control chart and record the numerical values of the MD (speed), DD (contrast) and B+F (gross fog) on the centerline of the appropriate areas of the control chart.

Baseline Operating Level (on the day of conversion)

a. Using a Sensitometer, expose and process five (5) sensitometric strips at the same time and on the same side of the processor.
b. Read and record the densities of each step of the sensitometric strip using the densitometer, including an area of processed film that has not been exposed.
c. Determine the average of the densities for each step using the densities for that step from the five strips.
c. Determine which step has an average density closest to 1.20. Designate this step as the mid-density (MD)/speed step.
e. Determine which step has a density closest to 2.20 and which step has a density closest to but not less than 0.45. The difference in densities between these two steps should be designated as the density difference (DD)/contrast.
f. Determine the average of the densities from the unexposed area of the five strips. This density will be designated as the base-plus-fog level (B+F) of the film.
g. Start a new Processor quality control chart and record the numerical values of the MD (speed), DD (contrast) and B+F on the centerline of the appropriate areas of the control chart.

These can be used as the baseline operating aims until the five-day averaging has been completed.

6. Automatic Exposure Control (AEC)

The desired optical density and operating kVp preference should be established. Refer to the **KODAK MIN-R EV Film System Mammography User Guide** (KODAK Publication # , Cat #) for a procedure to establish kVp and optical density for MIN-R EV Film.

Auto AEC/Phototimer recalibration is recommended after processing has stabilized.
Customers should consult their x-ray equipment manufacturer to ensure proper recalibration. If this is not performed at the time of conversion, then an interim AEC photo-timer adjustment should be determined. Using the appropriate tissue equivalent phantom, adjust the density control setting to achieve the desired optical density for the new screen/film system. **Due to the significant difference in the curve shape of Min-R EV film, optimum results for all breast types may not be achieved if the mammography x-ray unit is NOT calibrated for Min-R EV.**

Note: aims of the phantom QC should be adjusted once the calibration is performed if optical density or density difference change.

The following table shows system speeds for KODAK MIN-R EV Film with KODAK MIN-R EV Screens, and may be useful in determining an interim AEC adjustment.

Speed Contrast Comparisons for KODAK Mammography Film

Film	Screen	Processing Cycle	Relative Speed	Contrast		D-Max
				RP	EX II	
MIN-R EV	EV 150	Standard/Rapid	150	4.5	4.7	>4.5
MIN-R EV	EV 190	Standard/Rapid	190	4.5	4.7	>4.5
MIN-R 2000	2000	Standard	150	3.60	3.80	>4.0
MIN-R 2000	2190	Standard	190	3.60	3.80	>4.0
MIN-R 2000	MIN-R	Standard	100	3.60	3.80	>4.0
MIN-R L	2000	Standard	150	3.40	3.60	>4.0
MIN-R L	2190	Standard	190	3.40	3.60	>4.0
MIN-R L	MIN-R	Standard	100	3.40	3.60	>4.0

1 Relative speed determined from matched-density radiographs of a mammography phantom. KODAK MIN-R M Film and MIN-R Screen arbitrarily assigned a relative speed of 100.
2 Contrast was measured as the average gradient between densities 0.25 and 2.00 above gross fog using inverse square sensitometry

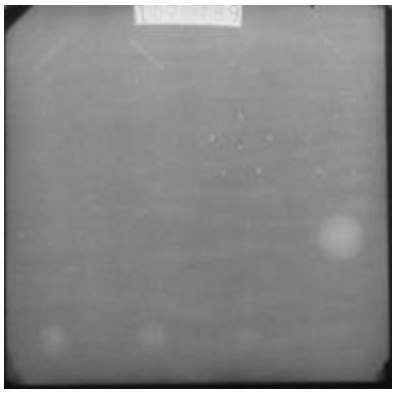
While system speeds may be similar, screen absorptions are different. Equipment adjustment will be necessary.

7. Evaluating the Imaging Chain for Uniformity

Description:

- Pattern of plus or minus density
- May appear either as a band or a diffuse region
- Readily seen on a flat field or phantom, rarely in the clinical image
- Can appear across the image, but seen most often in a uniform phantom along the chest wall side of the image

Picture:



Probable Cause or Causes:
The density pattern may be caused by a combination of factors in the exposing and processing of the film.

- **Grid/cassette holder**
  - Grid motor
  - Grid artifact/defect
  - Carbon fiber top damage
- **Dryer**

- Dryer temperature too high
- Air tubes blocked or obstructed
- Buildup on dryer rollers
- Squeegee rollers
- Dryer venting

- **Processor**
  - Hesitation in developer rack
  - Stubbing in developer rack
  - Processor type
    - Some processors have a better path through the developer, wash and dryer (e.g. Min-R Mammography or X-OMAT 5000 RA processor)
    - Note: In deep tank processors, test films should be processed emulsion up and down to determine best orientation for uniformity.
    - Films must be processed emulsion down in X-OMAT M35M, M35A-M and Min-R Mammography processors.

- **Chemistry**
  - Type and/or quality of the chemistry
    - Mixed and replenished properly

  Note: High contrast developers may increase the visualization of breast structure. Consequently, they may also enhance the visualization of any anomalies present in the imaging chain. The visualization of grid and dryer patterns may be more pronounced with these developers.

Isolating Non-Uniformity

Step 1. Determine if the artifact is coming from the processor or the X-ray exposure equipment

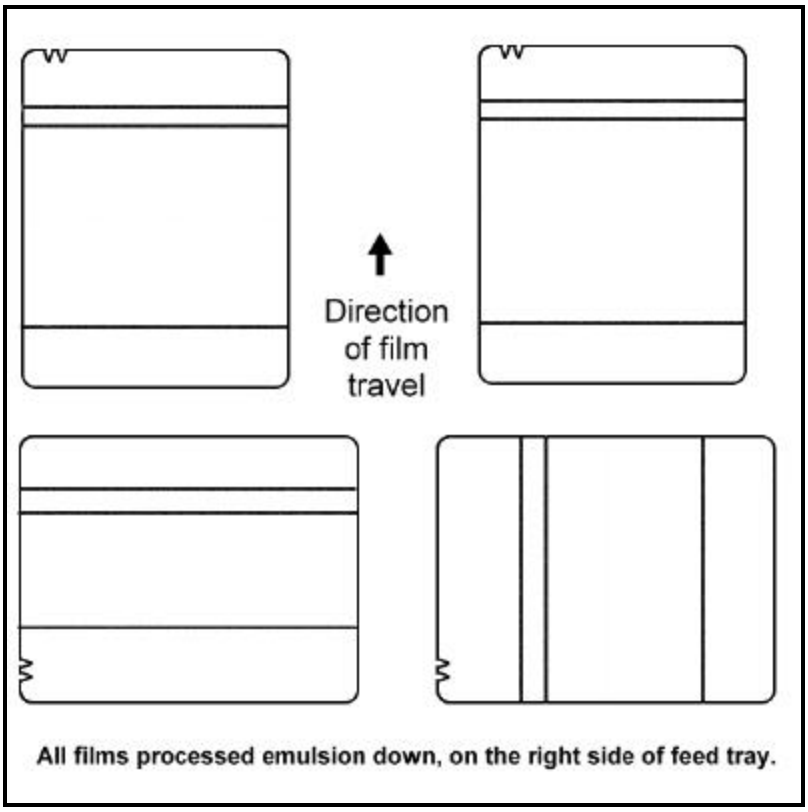
Equipment Needed

- 1 inch (2cm) thick uniform sheet of acrylic or Lucite
- Cassette with known good screen-film contact

The following procedure may be used to make this evaluation:
• Expose films to an optical density of 1.10 to 1.50, using the same cassette and the uniform sheet of acrylic.
—The exposure time used should be at least 0.5 seconds or longer to eliminate grid artifacts caused by too short an exposure time.
—The cassette must be known to have good screen-film contact.

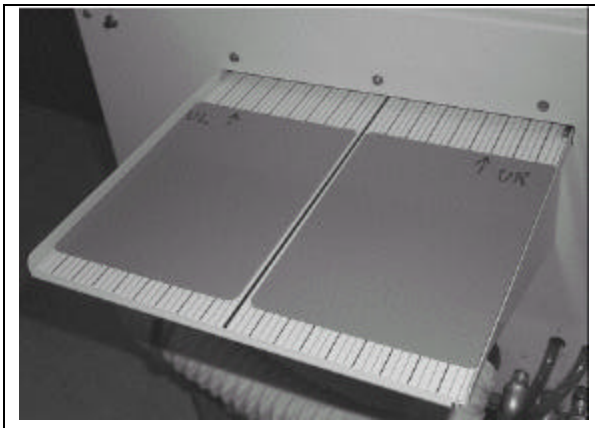
- Process one film so that the narrowest dimension of the film is the leading edge; process a second film so that the widest dimension of the film is the leading edge.
- Once processed, view the film pairs (or single films) in the same orientation as processed.
  - Artifacts that are parallel to each other on a film pair occurred in the processor (artifacts may be parallel or perpendicular to film travel).

Artifacts that are perpendicular to each other on a film pair occurred during exposure from the x-ray unit.



Artifacts that are parallel to each other are caused by the processor; artifacts that are perpendicular are caused during exposure.

If the artifact is processor caused:



- Lay the film on the film feed tray in the darkroom, and mark an arrow (↑) on the corner of the film with a lead pencil immediately before processing to indicate the direction of film travel.
- It is also helpful to mark the emulsion orientation (up [U] or down [D]), as well as which side of the processor feed tray (right [R] or left [L]) is being used, when feeding the film into the processor, e.g., ↑UR (emulsion up, right side feed tray)

Note that processors in which MIN-R EV Mammography film will be processed should be evaluated initially to determine whether films should be processed emulsion side up or emulsion side down--which orientation provides the best uniformity and the fewest artifacts--before processing clinical and quality control films.

- To thoroughly evaluate the entire processor, up to ten films should be exposed and processed as described above: one pair emulsion side up on the right side of the film

feed tray, one pair emulsion up on the left side of the feed tray, one pair emulsion side down on the right side of the film feed tray, and one pair emulsion side down on the left side of the film feed tray.

- Expose the first two film pairs that will be processed as described above (emulsion side up on right, emulsion side up on left) using the small moving grid device (18 x 24 cm bucky) and use to evaluate whether artifacts are being generated by the x-ray unit in conjunction with the small bucky.

• Careful analysis of all of the films will indicate whether emulsion side up or down gives the best overall processing results.

• the protocol should subsequently be posted in the darkroom so all films are processed consistently.

- All clinical images, sensitometric strips, and phantom images emulsion side up or all emulsion side down.

- Determine which side of the processor and which orientation (emulsion up or down) gives the best uniformity.

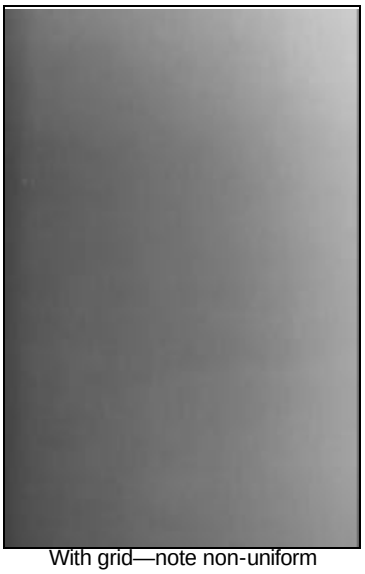
Film must be processed emulsion side down in the MIN-R Mammography, X-OMAT M-35AM, and X-OMAT M-35M Processors. (Multiloaders may be excluded as film orientation during processing is fixed.)

• Quality control films (phantom images and sensitometric strips) should also be processed in a specific location with respect to the film feed tray (right side or left side, with the edge of the film butted against the guide of the film feed tray).

Determine how much of the non-uniformity pattern is coming from the grid. Changes made to the processor will not be able to improve upon this.

- Expose with and without the grid.
  - Expose one film as normal and process emulsion side down on the non-gear side of the processor.
  - Make a table top exposure (set the loaded cassette on top of the table, place the Lucite on top and make the exposure) and process emulsion side down on the non-gear side of the processor.

Please contact the equipment manufacturer if the pattern is noticeable.



With grid—note non-uniform pattern

Without grid

Please record your results in Section 1 of the Troubleshooting Non-Uniformity worksheet.

Step 2. Test the ventilation of the processor by following the procedure outlined below

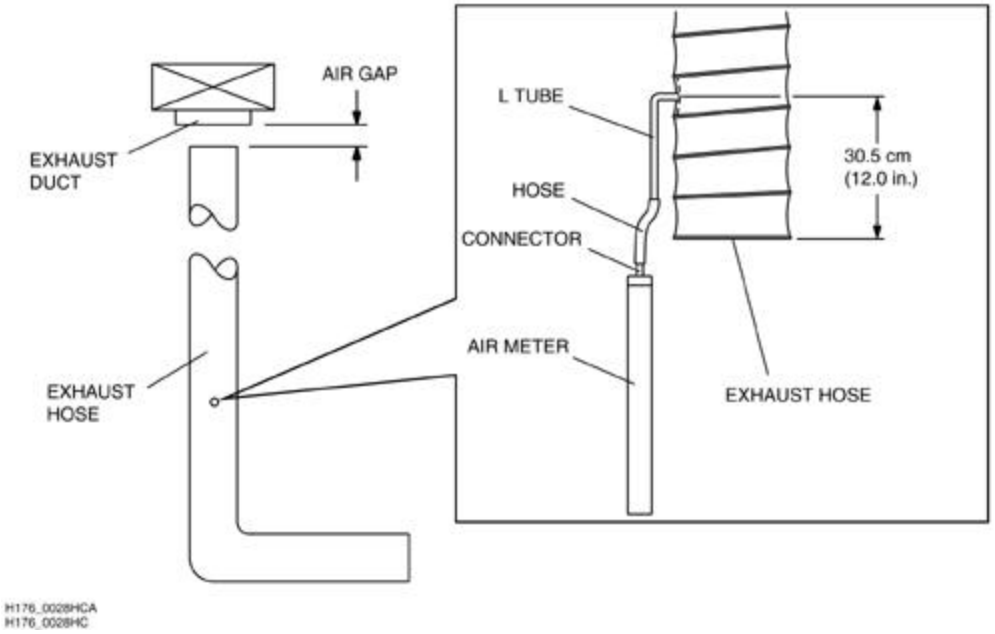
Failure to properly vent the processor or multiloader exhaust can cause corrosion inside the equipment (and any interfaced equipment) and can increase the probability of film artifacts. Venting according to the specifications outlined in this bulletin will help minimize these problems.

Some equipment (like the KODAK X-OMAT 5000 RA Processor) may have different procedures and specifications for exhaust measurement. Service documentation for a particular piece of equipment always takes precedence over these recommendations.

Items Needed

1. Air Meter (TL-2431).
The above item can be ordered through Service Parts Management at 800-431-7278 (U.S.) or 585-724-7278 (Outside U.S.).

STEP	ACTION
1	Make sure the processor/multiloader exhaust hose is connected to the building exhaust system. Disposal of effluent air must comply with prevailing environmental codes.
2	***Power down the processor/multiloader.***
3	Disconnect the exhaust hose from the rear of the equipment.
4	Connect the rubber hose on the Air Meter's **center** connector.
5	Connect the L Tube to the rubber hose.
6	Make a 6.4 mm (1/4 in.) hole approximately 30.5 cm (12 in.) from the end of the exhaust hose that will be connected to the processor.
7	Insert the L Tube into the hole (Step 6) so the end of the L Tube is flush with the inside of the exhaust hose and perpendicular to the wall of the exhaust hose.
Important: Do not connect the exhaust hose to the processor when checking negative static pressure.	



Procedure: Measuring the Static Pressure

Step	Action
1	Hold the air meter vertically to assure the greatest accuracy. Make sure the meter tubing is not kinked.
2	Record the average of several readings.
3	Compare the average reading with the information in the table below (Measuring the Static Pressure). **Important:** The negative airflow in the processor exhaust duct must remain constant when the processor is in the run, standby, and shut-down mode; therefore, the building exhaust system must be on 24 hours a day and have the same negative airflow throughout the day.
4	If the average reading is not within the tolerances specified in the table, adjust the Air Gap Assembly to obtain the tolerances. If the tolerances still cannot be obtained and you must exceed the maximum in order to obtain the correct negative static pressure, contact site management personnel to have the building exhaust corrected. **Important:** There must be an adequate air gap (maximum 5.08 cm / 2 inches) between the processor exhaust hose and the building exhaust to prevent positive airflow from flowing back into the processor. If the building exhaust venting system cannot meet specifications, an Auxiliary Ventilation Fan Kit can be ordered through Service Parts Management.
5	Reconnect the exhaust hose to the processor.

Measuring the Static Pressure

Duct Diameter	Negative Static Pressure of Water Head	
	Minimum	Maximum
76 mm (3 in)	0.76 mm (0.03 in.)	1.02 mm (0.04 in.)
102 mm (4 in.)	0.25 mm (0.01 in.)	0.51 mm (0.o02 in.)

Additional Notes
If the processor/multiloader is installed in a darkroom wall opening, the darkroom air pressure *must exceed the air pressure of the area outside the darkroom.* This will:
• Prevent air from cascading through the processor and into the darkroom area.
• Assure correct dryer venting.
• Minimize chemical fume and vapor containment inside the processor and its dryer exhausting system.
• Reduce film artifacts in the out-of-solution transport roller sections.
• Reduce corrosion of the processor/multiloader.

Room Ventilation

The room must have a minimum of 10 air exchanges each hour.

Record your results in Section 2 of the Troubleshooting Non-Uniformity worksheet.

Step 3. Having ruled out the x-ray unit and grid and the ventilation as causes of the uneven density, look at the films by reflected light to see if the uneven density pattern is visible.

To rule out the dryer as a cause, expose several additional flat field films, following the procedure above. Process the first film in the orientation that gave you the best results in step 1 and catch it as it exits the wash rack prior to entering the dryer section. Let it air dry.

	The dryer pattern exhibited on the left is visible by both reflected and transmitted light. It may be minimized by following the recommendations on pages 15-16 of this document.

Examine the film to see if the non-uniformity changes. If it does, then follow the corrective actions for dryer pattern. Record your results in Section 3 of the Troubleshooting Non-Uniformity Worksheet.

Step 4. If the uneven density pattern does not change in step 3, try to isolate which rack in the processor it may be occurring.

Record your results in Section 4 of the Troubleshooting Non-Uniformity worksheet.

Corrective Action (according to cause):

Symptom	Cause	Corrective Action
Grid non-uniformity		Contact your x-ray equipment manufacturer.
Shoreline Artifacts (visible in both transmitted	Dryer Temperature too high	Turn down dryer temperature as low as possible to dry the film.

and reflected light)	Air tubes blocked or obstructed	Clean air tubes (Check at each PM or as needed) Try rotating several air tubes by 180 degrees
	Wash rack squeegee rollers	Squeegee rollers must be clean and in good working order. (Check imperfections, spring pressure, smooth rotation, etc.)
	Poor ventilation	Check the ventilation as per procedure in Service Bulletin No. 101.
	Improperly mixed, under-replenished developer and fixer	Review mixing procedures Verify that the replenishment rates are set appropriately (as per Service Bulletin No. 30 recommendations).
Hesitation Marks/stub lines (visible in transmitted light)	Change in velocity of the film travel resulting from interference within the film path	
	Malfunctioning rack or drive component (roller, gear, chain, drive motor or sprocket)	Repair or replace rollers, bearings, shafts, sideplates, gears, gudgeons and guide shoes
	Incorrectly assembled or damaged guide shoes	Check that the guide shoes are not loose and are positioned in the correct direction
	Guide Shoes out of adjustment or out of alignment	Check that the developer rack and developer/fixer crossover are assembled correctly
	Chemical buildup on rollers	Inspect all rollers for dirt and buildup of dried chemicals. Clean the rollers according to manufacturer's recommendations.
	Warped or rough rollers	
	Worn roller bearings, shafts and sideplates	Check that the sideplates of the guide shoes are correctly oriented
	Idler rollers not turning	Adjust rack chains
	Damaged gear or gudgeon	
	Improperly mixed or depleted developer and/or fixer	Review mixing procedures Verify that the replenishment rates are set as per Service Bulletin No. 30 recommendations.

As per the guidance on page 255 of the ACR's **Mammography Quality Control Manual 1999** "If **significant** film processor artifacts are detected, contact the person maintaining the processor or the film processor service organization or dealer. Contact the X-ray equipment service person for suggestions on additional testing procedures and for help in correcting X-ray equipment artifacts. Gentle cleaning may be able to eliminate cassette or screen artifacts. Not all artifacts can be totally eliminated. It may be helpful to use the concept of ALARA (as low as reasonably achievable) when attacking artifacts. If they can be easily eliminated, they should. If the artifact is difficult or expensive to eliminate and is subtle (not mimicking or obscuring clinical information), it

may be tolerable. The medical physicist should consult with the interpreting physician as to whether the artifact is tolerable."

Troubleshooting Non-Uniformity Worksheet

Section 1). Determine if the artifact is coming from the processor or the X-ray exposure equipment

After completing the tests on pages 10-12, please compare the test films and record your results below:

Grid versus non bucky comparison: _____

Emulsion Up versus Emulsion Down comparison: _____

Non-gear versus gear side of processor: _____

Section 2). Determine the ventilation of the processor

Record your results and compare to Kodak's recommendations on page 14:

Negative static pressure: _____ Results within Kodak's recommendations? Y N

Section 3) Ruling out the dryer as a cause of the uneven density pattern

Perform the test as outlined on page 15.

Examine the resulting films to see if the uneven density pattern changes.

Record your results:

Did the dryer pattern change? Yes No

If it does, then follow the corrective action for dryer pattern on page.

Section 4) If the uneven density pattern does not change, try to isolate which rack in the processor in which it may be occurring.

Results:

Pattern was isolated in the: developer rack fixer rack wash rack

Could not isolate pattern.

If you cannot isolate the cause of the pattern, please send a copy of this form, your test films and the completed Information Needed by Kodak to Facilitate Troubleshooting form to:

Eastman Kodak Company
Health Imaging Technical Support
343 State Street
Rochester, NY 14650-1131

8. Other Mammography Quality Control Tests

- *Emulsion Log*
  See **KODAK MIN-R EV Film System User Guide** (KODAK Publication #, Cat #).
  - *Phantom Image Evaluation*
    Perform the test as described in the Mammography Quality Control Manual for Radiologists, Medical Physicists, and Technologists, American College of Radiology 1999 (ACR QC Manual) page 258.
    - Note any changes in the number of test objects seen. Re-establish the baseline numbers.
    - The density difference on the phantom may be significantly higher due to the high contrast of KODAK MIN-R EV Film.
  - *Darkroom Fog Test*
    Perform the test as described in the **KODAK MIN-R EV Film System User Guide** (KODAK Publication # , Cat #). Please note that a 7.5 watt bulb is recommended with KODAK mammography film.
  - *Analysis of Fixer Retention in Film*
    Perform the test as described in the **KODAK MIN-R EV Film System User Guide** (KODAK Publication # , Cat #).

  The conversion to MIN-R EV Film includes a conversion to new KODAK MIN-R EV Screens. The following tests should be performed:

  - *Screen-Film Contact*
    Perform the test as described in the **KODAK MIN-R EV Film System User Guide**.
  - *Uniformity of Screen Speed*
    Perform the test as described in the **KODAK MIN-R EV Film System User Guide** (KODAK Publication #, Cat #).

For More Information:

Outside U.S. please contact your local Kodak representative.

U.S. Distributors Contact:
Health Imaging
Technical Support
1-800-328-2910 (option 1 for faxback)

CES Personnel Contact:
Film Handling TAC
U.S.: 1-800-328-2910
Canada: 1-800-433-1414