Processing KODAK Motion Picture Films, Module 8

Effects of Mechanical & Chemical Variations in Process ECN-2

Kodak

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8 Effects of Mechanical & Chemical Variations in Process ECN-2

PROCESS CONTROL

The successful processing of KODAK VISION2 and VISION3 Color Negative Films requires a good process control system. The essential phases of such a control system include mechanical, chemical, and photographic control, plus correlation and interpretation of results. The philosophy and a recommended system of process control are given in Module 1, *Process Control*. The following sections are specific for Process ECN-2.

Mechanical Control

Mechanical control includes items basic to any chemical reaction, such as temperature, agitation, and time of reaction. The developer temperature for Process ECN-2 should be maintained tightly within specifications. The temperatures of other solutions, while not quite so critical, must nevertheless be carefully controlled. Recirculation and replenishment rates must be regulated to maintain the required chemical activity of the various solutions. Turbulated solutions should be piped through devices that indicate the rates of flow and pressures so that the jet-agitation action of the solution at the film surface can be controlled. A method for calibrating and measuring flow rates is given in Module 2, *Equipment and Procedures*. The operating speed of the processing machine should be checked frequently. All such factors, whether regulated automatically or manually, constitute the physical or mechanical aspects of control. See Table 8-2, *Checklist for Daily Operation* of a process machine running Process ECN-2.

Chemical Control

Maintaining the proper composition of the processing solutions is one of the most important elements of control. Maintain the chemical composition of the solutions within the published tolerances to achieve satisfactory process control. Do not compensate for chemical imbalances by altering mechanical parameters. This action is not good process control procedure and is not recommended.

Use the Analytical Methods recommended in Module 3, *Analytical Procedures*, to determine the chemical composition of each processing solution. Some of the methods require the use of a pH meter to accurately measure solution acidity or alkalinity. An automatic titrator or pH meter is required for potentiometric titrations. A spectrophotometer is required to measure constituents in some processing solutions. With these three instruments plus chemical reagents and the assorted glassware (pipets, burets, hydrometers, beakers, etc,) usually found in analytical laboratories, all of the solutions used in the process can be analyzed. Table 8-1, *Critical Chemical Analyses for Process ECN-2* shows the method number for each analysis that is performed on each Process ECN-2 solution.

Table 8-1
Critical Chemical Analyses for Process ECN-2

Solution	Analyses	Tank	Replenisher	Method Number
Prebath	pH Specific Gravity	W, F W, F	F F	ULM-191-2 ULM-0002/1
Developer	pH Specific Gravity Total Alkalinity CD-3 Bromide Anti-Fog, No. 9 Sulfite	D, F M, F M, F W, F W, F W, F W, F	F F F F F F F	ULM-191-2 ULM-0002/1 ECN-0001/1 ECN-0003/1 ECN-926C ECN-157OC ECN-1305B
Stop	pH	W, F	F	ULM-191-2
Bleach, Ferricyanide	pH Specific Gravity Ferricyanide Bromide	W, F M, F W, F M, F	F F F F	ULM-191-2 ULM-0002/1 ECN-00021/1 ECN-0004/1
UL Bleach*	pH Specific Gravity Bromide Iron II, III Total Iron	W, F M, F W, F W, F W, F	F F F F F	ULM-191-2 ULM-0002/1 ECN-0022/1 ECN-2-3275 ECN-2-3263
KUL Bleach*	pH Specific Gravity Bromide Iron II, III Total Iron	W, F M, F W, F W, F W, F	F F F F F	ULM-191-2 ULM-0002/1 ECN-0005/1 ECN-0007/1 ECN-0006/1
Accelerator (Persulfate Bleach)*	pH Specific Gravity Metabisulfite Buffer Capacity PBA-1	W, F M, F W, F M, F W, F	F F F F F	ULM-191-2 ULM-0002/1 ECN-1340 ECN-2-755 ECN-2100B
Bleach Persulfate*	pH Specific Gravity Persulfate Chloride Buffer Capacity	W, F M, F W, F W, F M, F	F F F F F	ULM-191-2 ULM-0002/1 ECN-0024/1 ECN-0009/1 ECN-0019-01
Fixer	pH Specific Gravity Hypo Index Thiosulfate Sulfite	W, F M, F W, F W, F W, F	F F F F F	ULM-191-2 ULM-0002/1 ECN-0002/1 ECN-0002/1 ECN-0002/1
D=Daily W=Weekly M=Monthly F=Each Fresh Mix				

* Alternate Bleach

Table 8-2 Checklist for Daily Operation

Steps		Spec.	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
1.Was shutdown strip in control?									
2.Turn on power, air and water supplies, and the exhaust system.									
3.Check solution levels* in machine tanks.									
4.Check replenisher supply tanks and make fresh replenishment solutions if necessary.	Prebath								
	Developer								
	Stop								
	Accelerator (if used)								
	Bleach								
	Fixer								
	Final Rinse								
5.Turn on recirculation pumps.									
6.Adjust wash-water flow-meters to proper setting.									
7.Turn on and check air supply to squeegees.									
8.Turn on temperature control systems.									
9.Turn on replenishers. Use leader rates until film is being processed.									
10.Turn on dryer fan motor and heater.									
11.Start machine and check machine speed.									
12.Check final squeegee for cleanliness and adjustment. Make corrections if necessary.									
13.Check leader for twists.									
14.Check solution time.	Prebath								
	Developer								
15.Use KODAK Process Thermometer, Type 3. Check solution temperature.†	Prebath								
	Developer								
	Accelerator (if used)								
16.Check recirculation rate.	Prebath								
	Developer								
	Stop								
	Accelerator (if used)								
	Bleach								
	Fixer								
	Final Rinse								
17.Run control strips.									
18.Proceed to production if in control.									
19.Check replenisher flow rate.†	Prebath								
	Developer								
	Stop								
	Wash								
	Accelerator (if used)								
	Bleach								
	Fixer								
	Wash								
	Final Rinse								

* Solution levels must be high enough in the weir boxes to prevent air from being drawn into the recirculation systems when recirculator pumps are turned on.

† Start-up and every two hours.

Analyze all fresh chemical mixes, as the first defense against mixing errors. The tank solutions should be checked on a regular basis to monitor any changes in the chemical composition. The most useful analysis is pH. It is relatively easy to measure and must be done on a daily basis. A drift in developer pH is usually the first warning of a process about to go out of control. When such drifts are observed, it is important to try to find the cause, rather than to blindly adjust the pH and continue processing. In most cases, this will require a complete developer analysis.

Table 8-1, *Critical Chemical Analyses for Process ECN-2* indicates a starting point for the frequency of analysis. The schedule of analysis can be customized by a particular installation to keep its process in chemical control. The customized frequency will depend on the amount of film being processed, and the historical stability of the process.

Photographic and Sensitometric Control

The chemical reactions involved in processing color films are so complex that it is impossible to evaluate and control the process completely on the basis of mechanical and chemical data alone. The end results are photographic and include the characteristics of the sensitized material and the chemicals of the process. Actual picture tests demonstrate how the process behaves photographically. It is possible, although cumbersome, to use such tests for photographic control. Apart from rigorous photographic control, however, viewing printed picture work off a process is important because it is an indication of the overall photographic condition of the process, both sensitometric and physical.

The best process control methods furnish quantitative information about the process. Sensitometric control strips provide a rapid, accurate and greatly simplified means of evaluating the process photographically. Introduce strips into the process with regular production footage every one or two hours. Evaluate visually, or more precisely, by densitometric methods. Examine the strips immediately after processing and plot the results on the same charts where the mechanical and chemical data are recorded. This information gives a time related check on whether accidents have occurred causing the process to drift away from the process aim. See Module 1, *Process Control*, Figure 1-7 *Typical Control Chart* for examples.

For your convenience, sensitometrically exposed control strips are available from Eastman Kodak Company. KODAK VISION Color Negative Control Strips, Process ECN-2, are exposed on KODAK VISION3 200T Color Negative Film 5213. They are packaged in 100-foot rolls containing at least 120 exposures and a processed reference strip. The exposures on the roll are spaced at 9.5-inch intervals. Each exposure has 21 gray-scale steps at 0.20 log H increments (2/3 camera stop). The reference strip is exposed exactly as the control strips and is subsequently processed under well-controlled conditions. The instruction sheet contains correction factors that are required to establish your process aims. A four-digit code number appears on the carton, can, control strips, reference strip, and instruction sheet, identifying each production batch of strips. The procedures for using control strips are found in Module 1, *Process Control*.

Correlation of Mechanical, Chemical, and Sensitometric Data

Record and interpret all mechanical, chemical, and photographic results, to monitor whether the process is in or out of control. If the process drifts out of control, your control records should indicate what corrective action was taken to reestablish control.

As your experience increases with Process ECN-2, you will accumulate mechanical, chemical, and sensitometric data under many conditions. This reference will indicate what photographic results to expect when various mechanical and chemical changes occur.

Until experience is gained with Process ECN-2, it is important to know generally what photographic effects to expect as a result of chemical or mechanical variations, and approximately what magnitude of change produces a noticeable photographic effect. This information can help you diagnose a photographically off-balance condition.

Effects of Mechanical and Chemical Variations —5213, 5254, and 5242 Film in Process ECN-2 Developer

Sample Control Plots

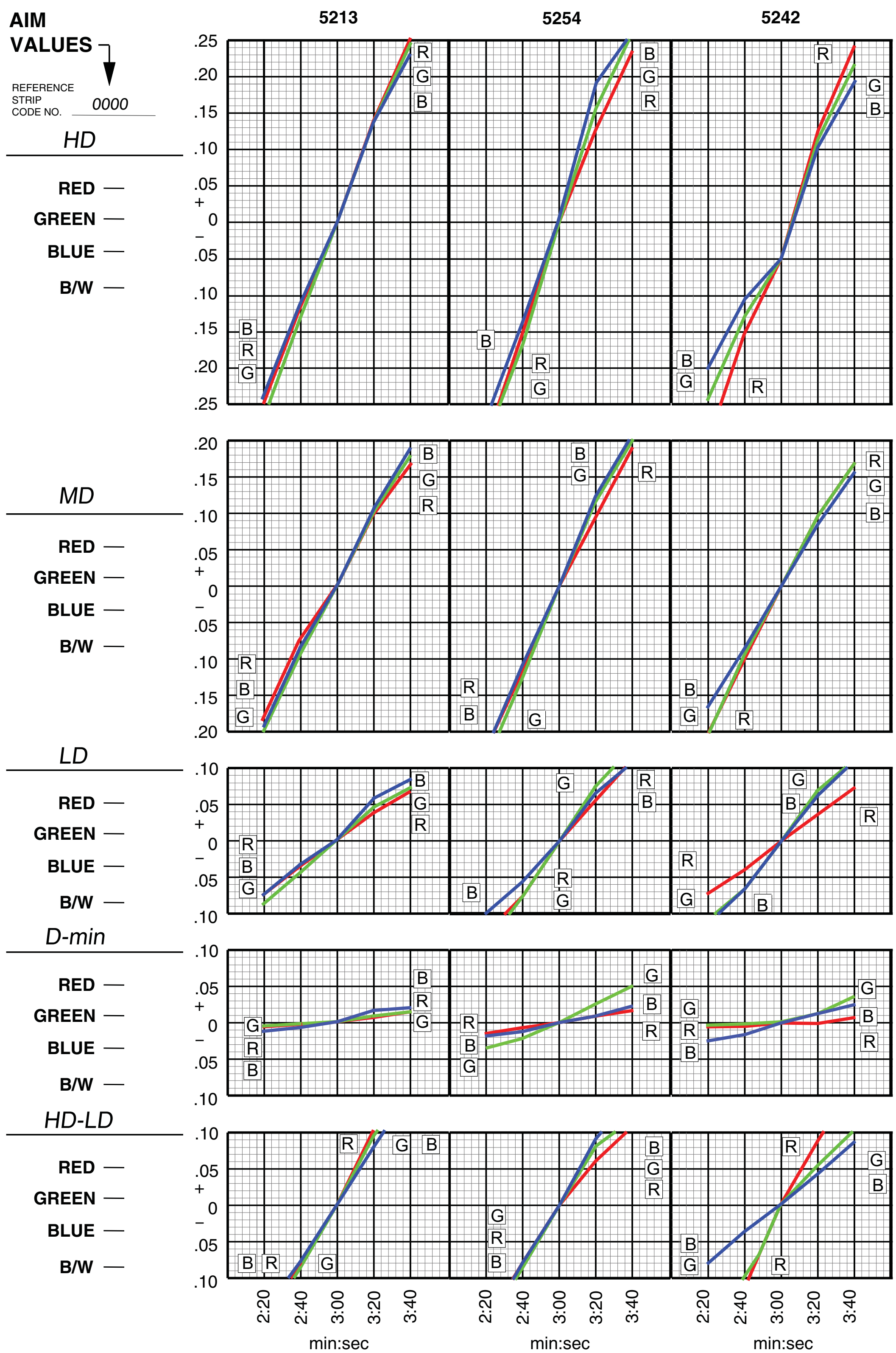
The sample control plots in this section illustrate some of the major photographic effects of mechanical and chemical variations on KODAK VISION3 200T Color Negative Film 5213, KODAK VISION3 Color Digital Intermediate Film 5254, and KODAK VISION Color Intermediate Film 5242. Each plot shows the effect of a change in a process variable (horizontal axis), on the dye density of the processed film (vertical axis). These density plots are deviated against the standard level for each variable (i.e. standard level for the variable is represented by zero density).

The magnitude of the changes shown in these plots should not be considered to be process control limits. Also, the data presented are qualitative, not quantitative. The plots were derived from experiments using small laboratory machines in which all constituents were held constant except the variable being studied. Hence, the figures should be used only as trend charts and guides. If two or more process variable are changed, the resulting photographic effect illustrated may not be additive. Interactions can occur that produce effects other than those predicted by addition. The plots in this publication are representative only; they do not contain all possible solution problems. Most of the important photographic effects take place in the developer.

The *Color Negative Film Diagnostic Charts* are diagnostic schemes for the process and highlight the importance of not only the developer, but also the stop, bleach and fixer.

Developer Mechanical Factors

Figure 8-1 Effects of Time Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



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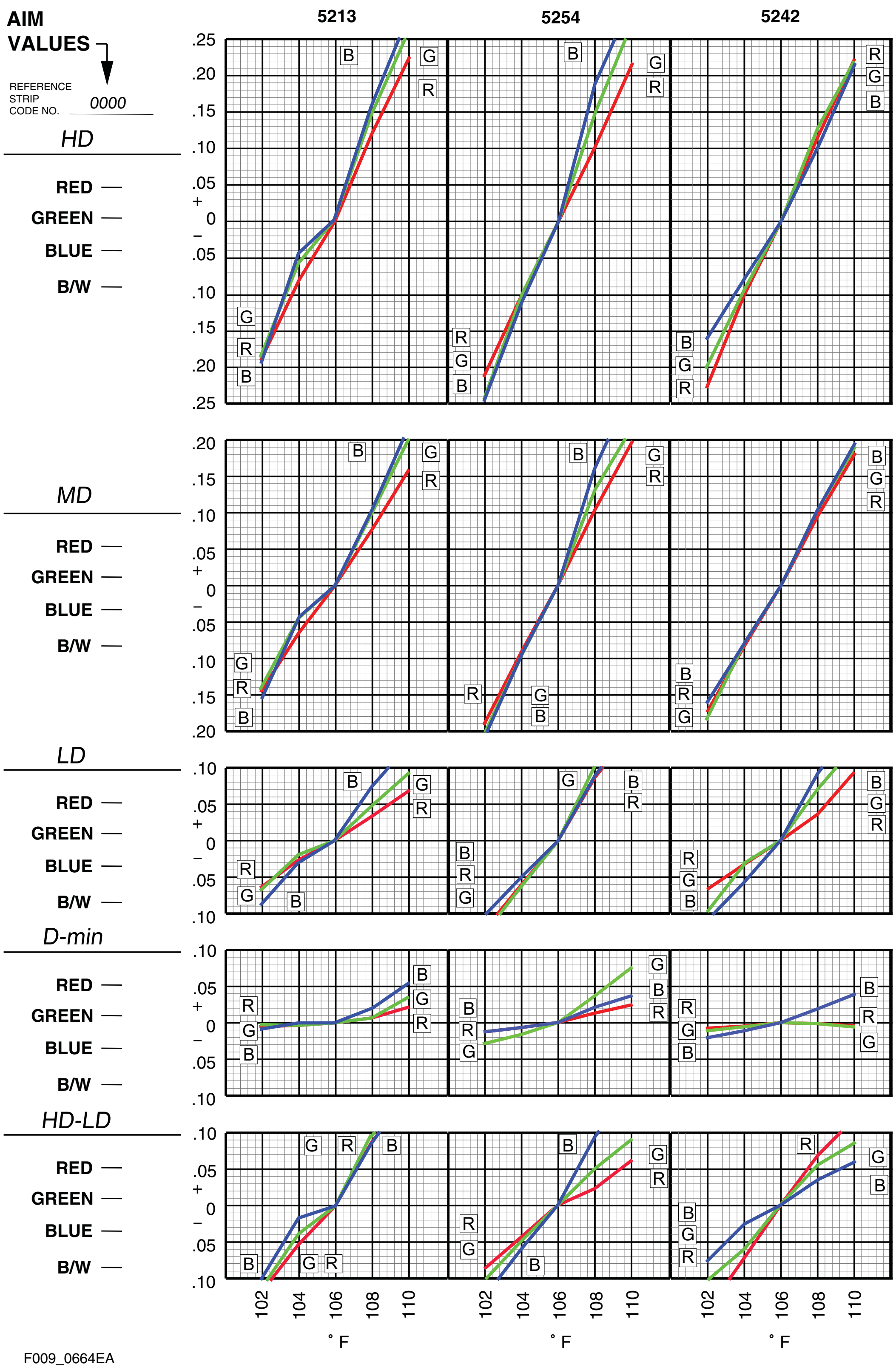
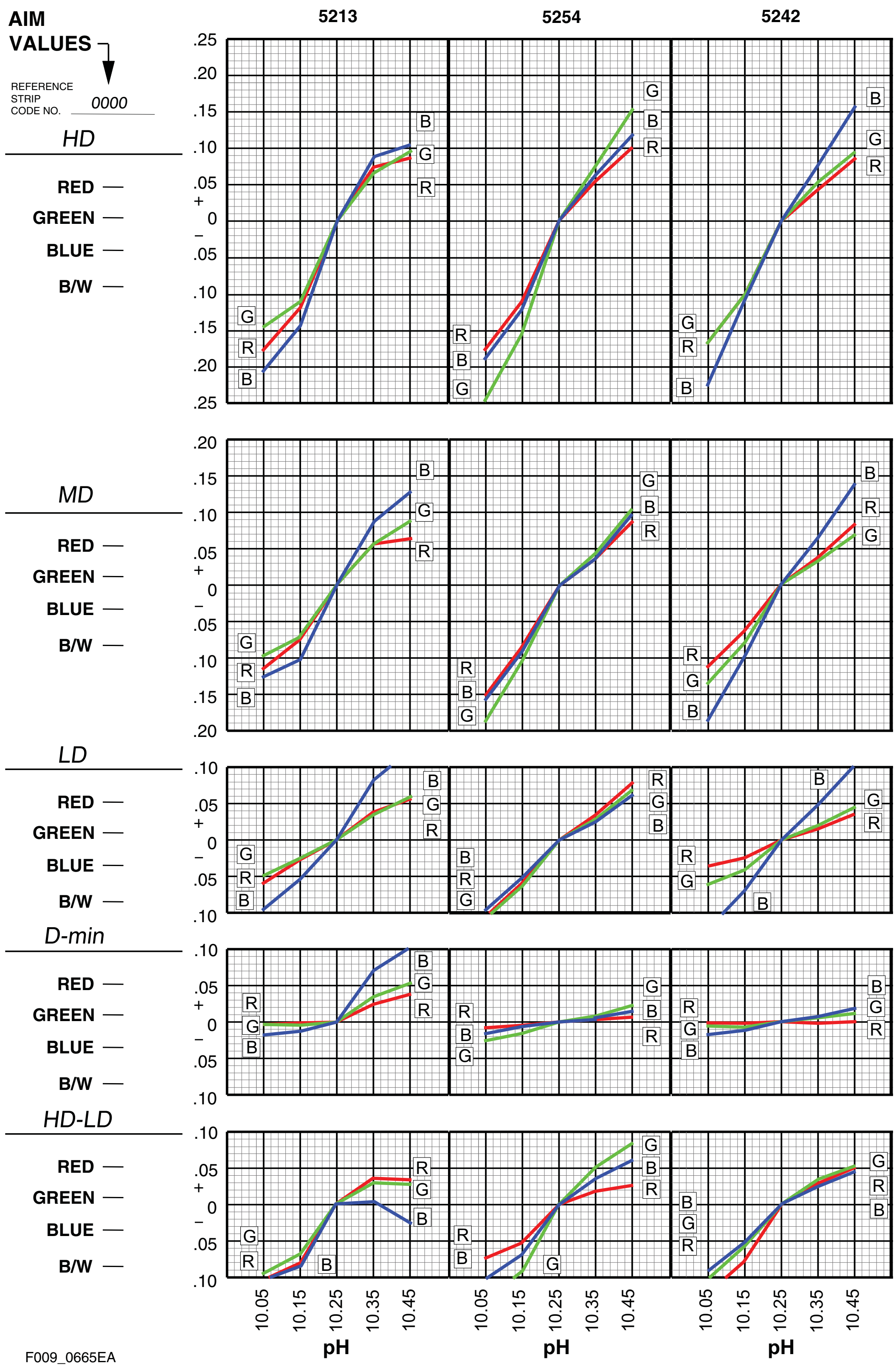
Developer Mechanical Factors

Figure 8-2 Effects of Temperature Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



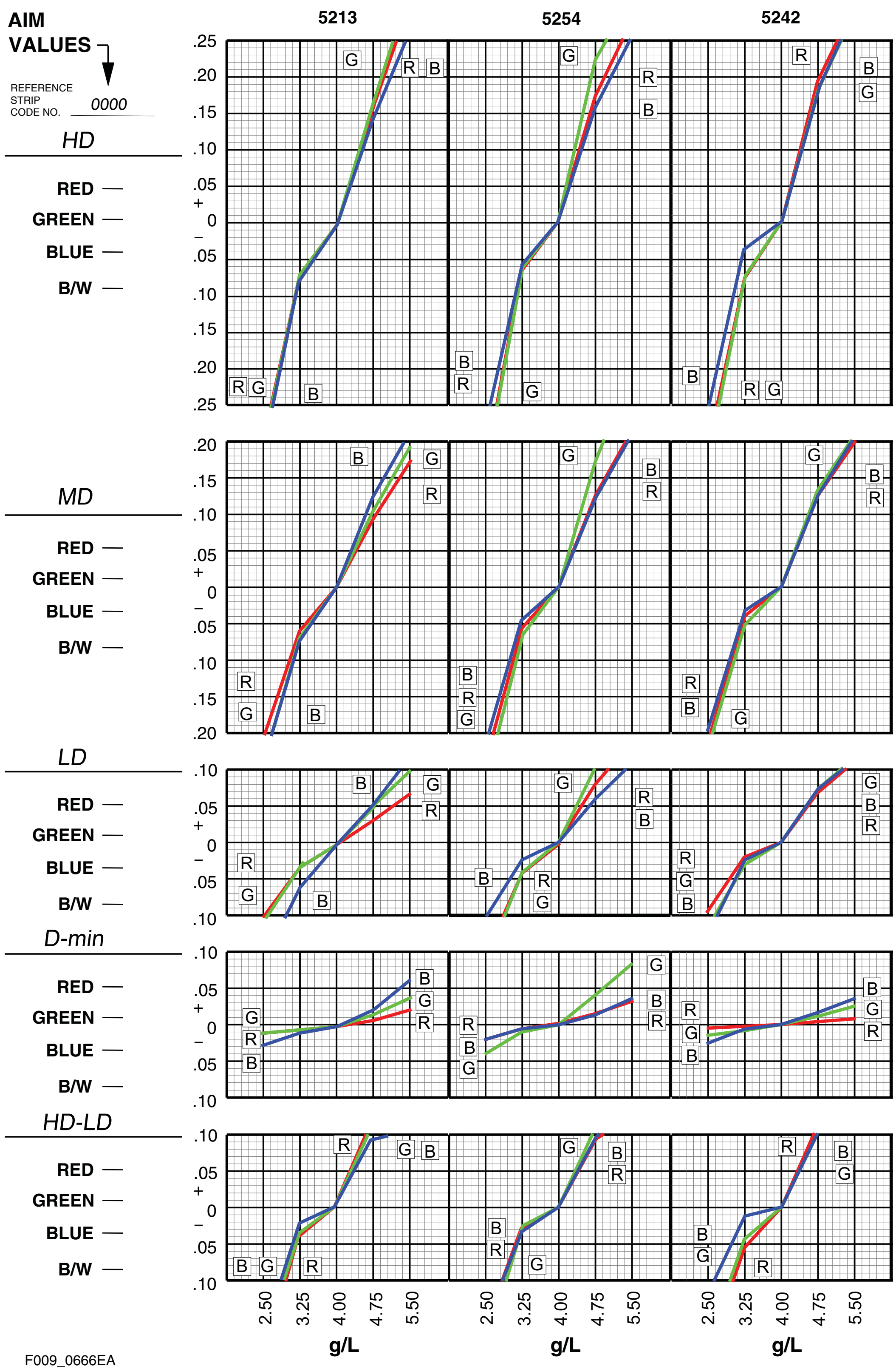
Developer Chemical Factors

Figure 8-3 Effects of pH Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



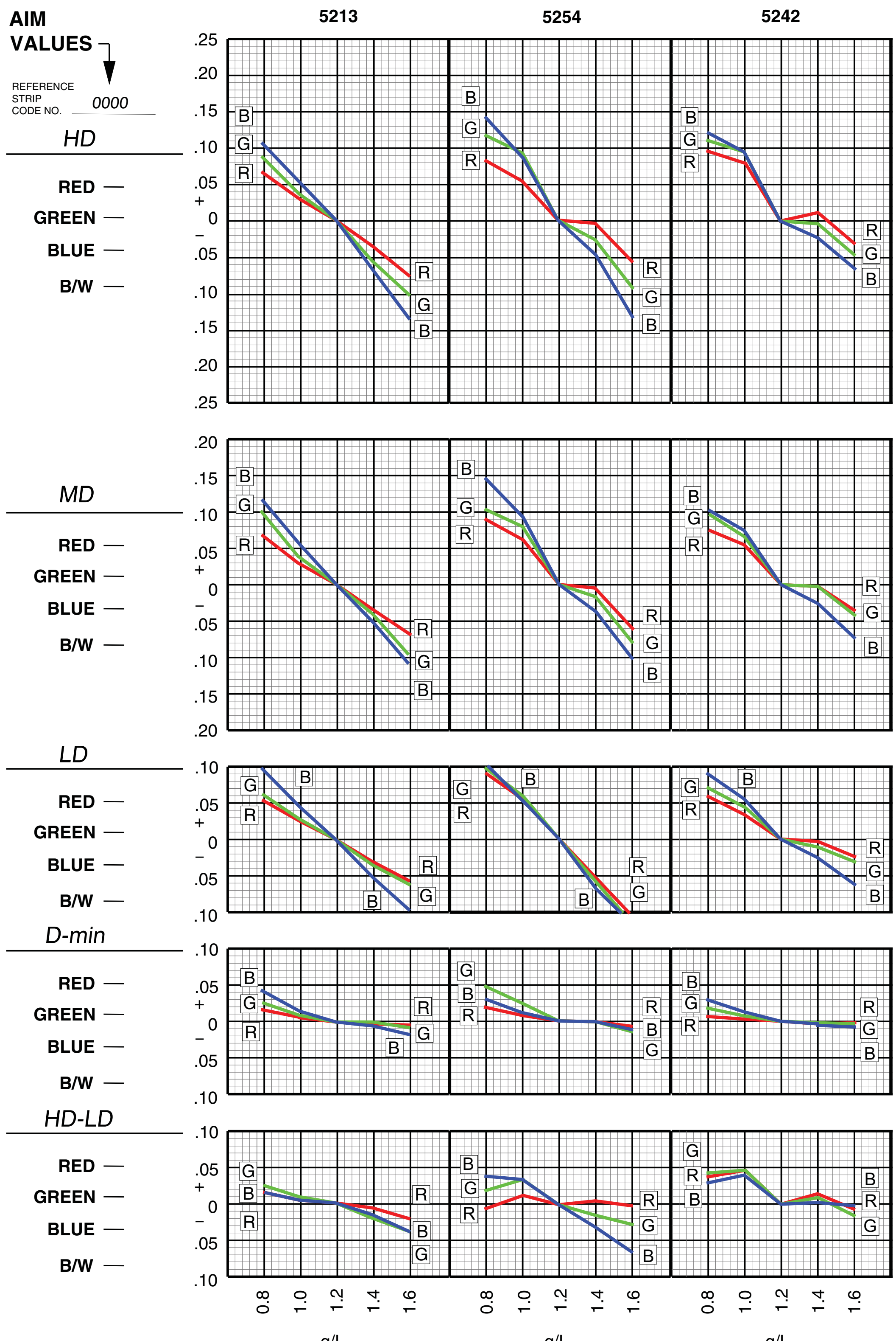
Developer Chemical Factors

Figure 8-4 Effects of CD-3 Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



Developer Chemical Factors

Figure 8-5 Effects of NaBr Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



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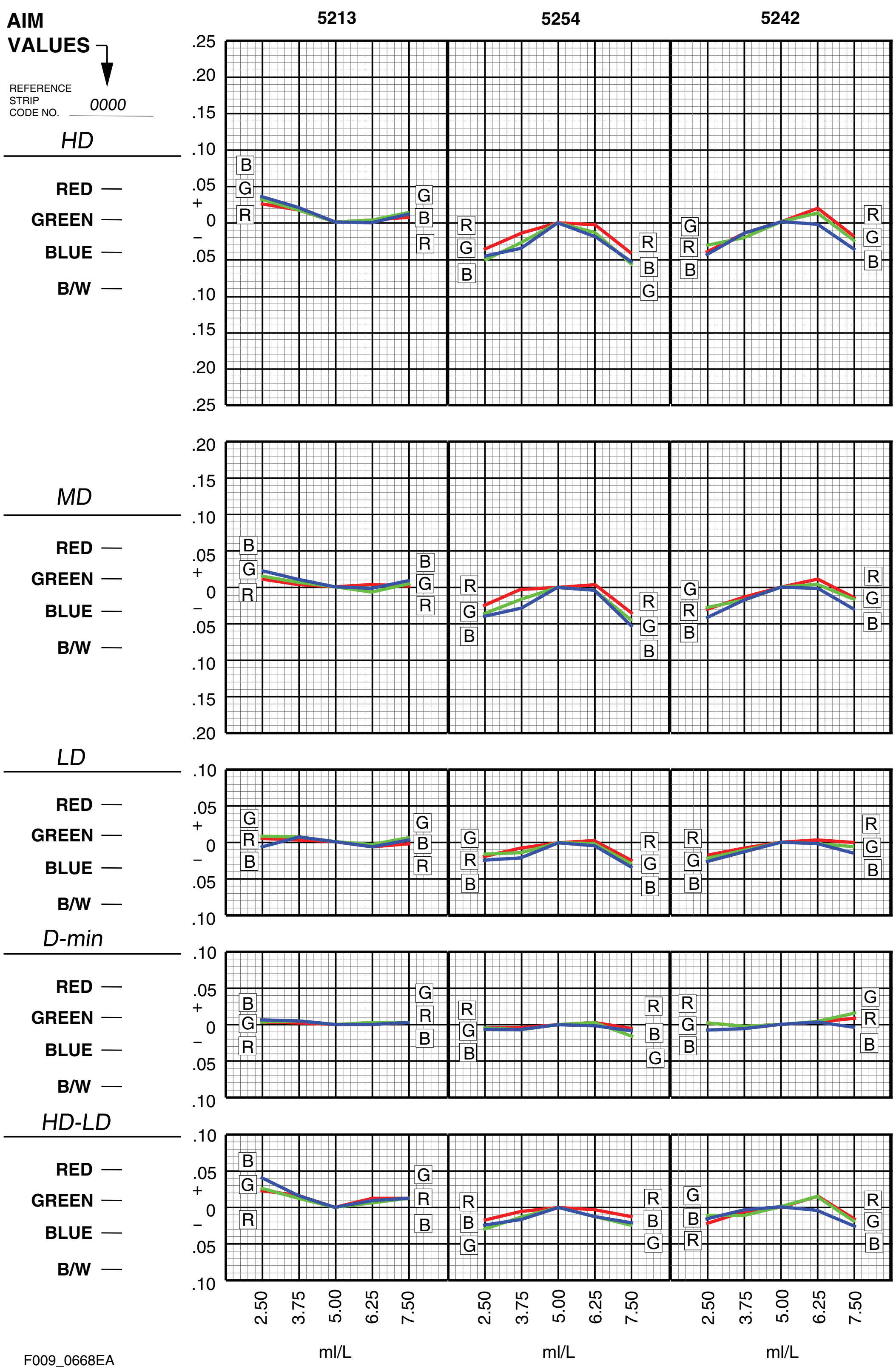
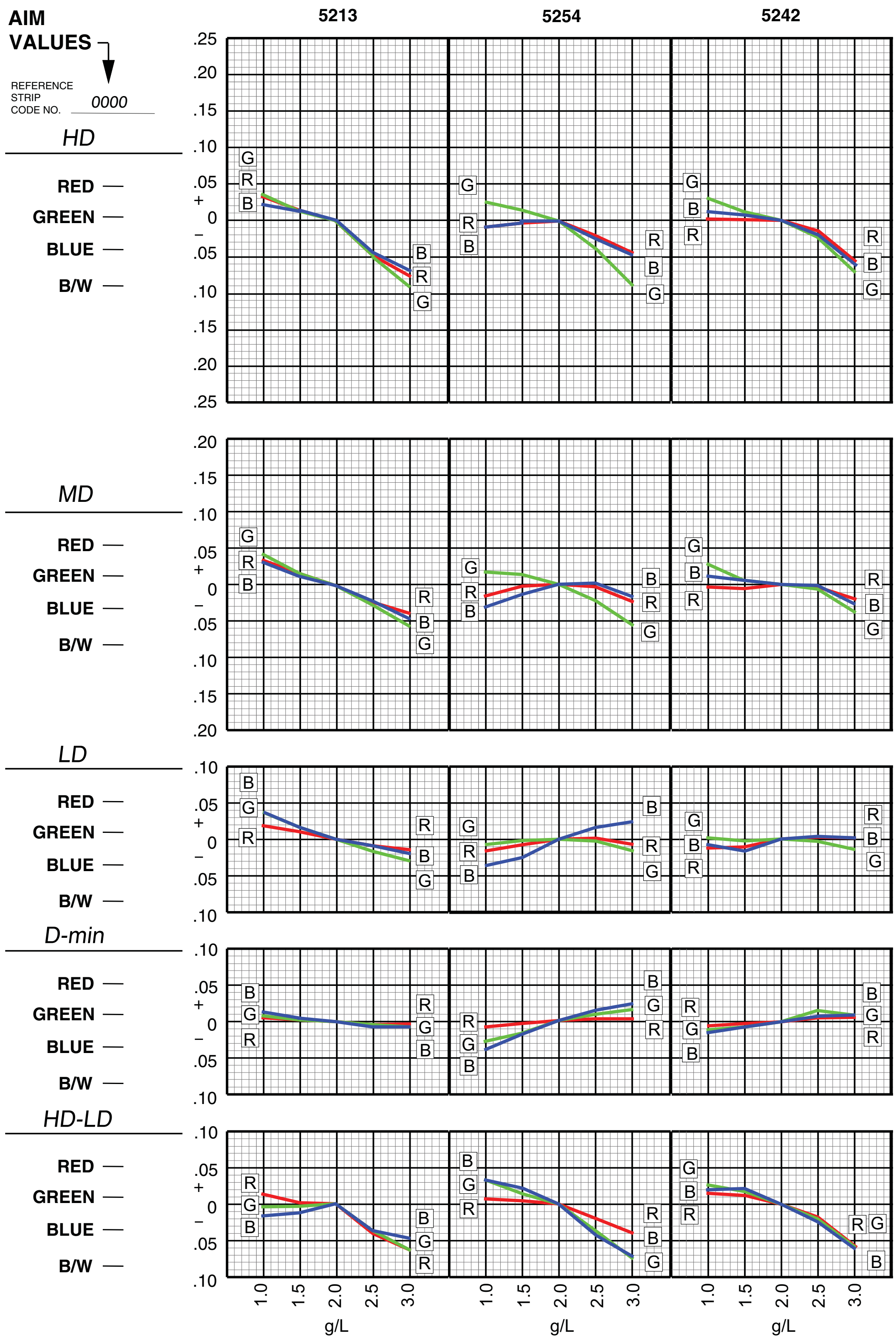
Developer Chemical Factors

Figure 8-6 Effects of AF2000 Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



Developer Chemical Factors

Figure 8-7 Effects of Na_2SO_3 Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



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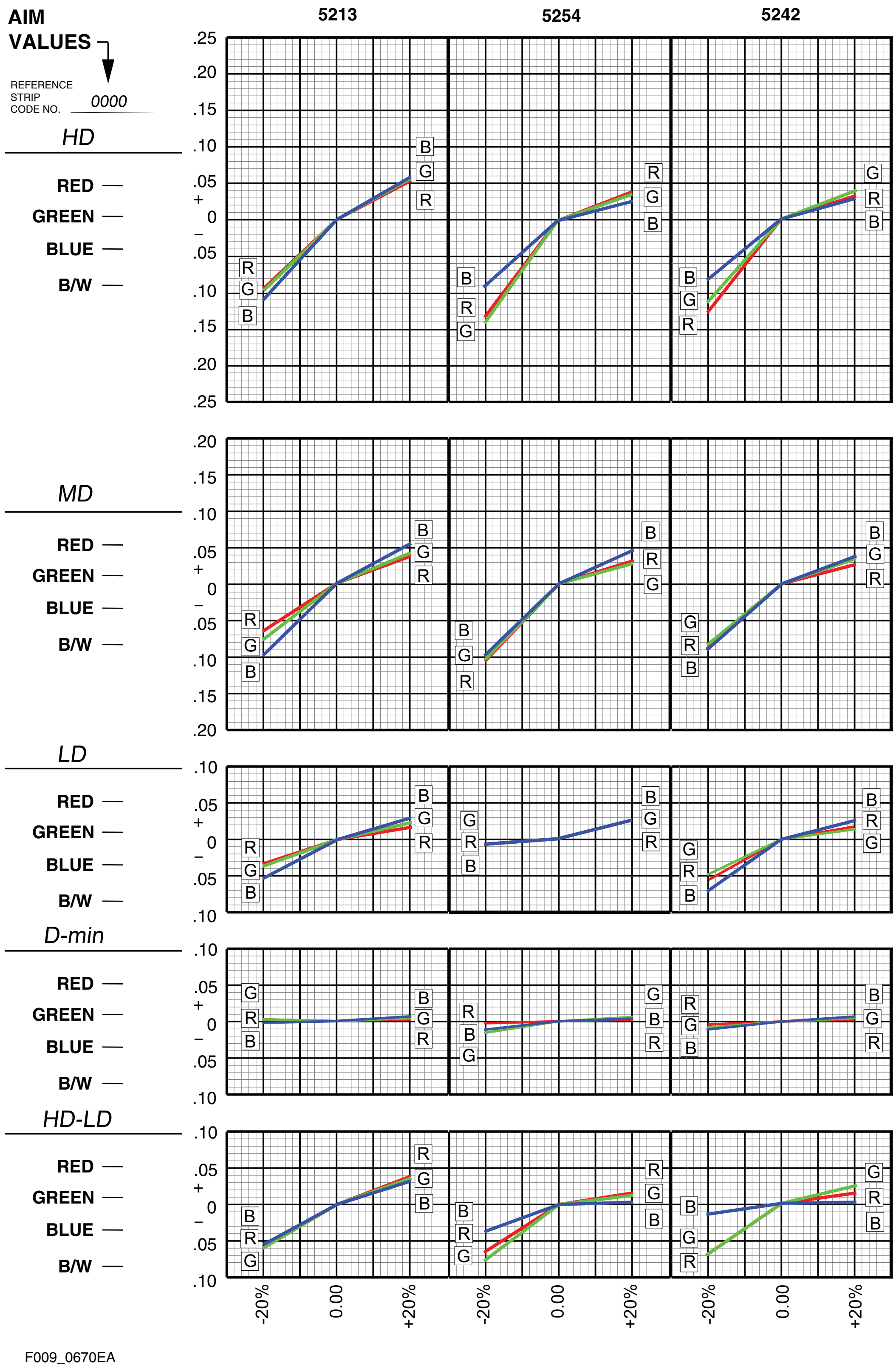
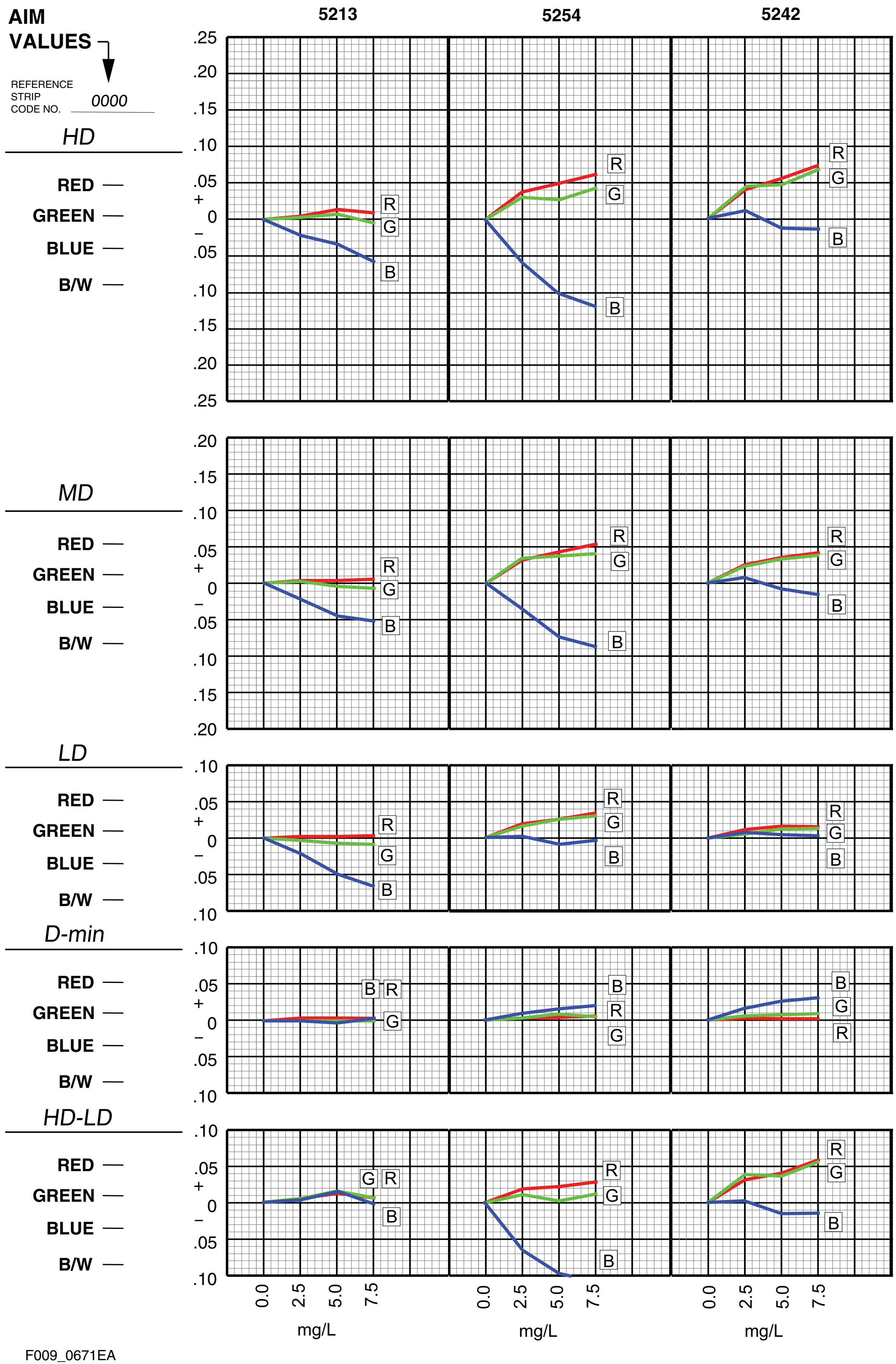
Developer Chemical Factors

Figure 8-8 Effects of Under and Overreplenishment Variations—5213, 5254, and 5242 Films in Process ECN-2 Developer



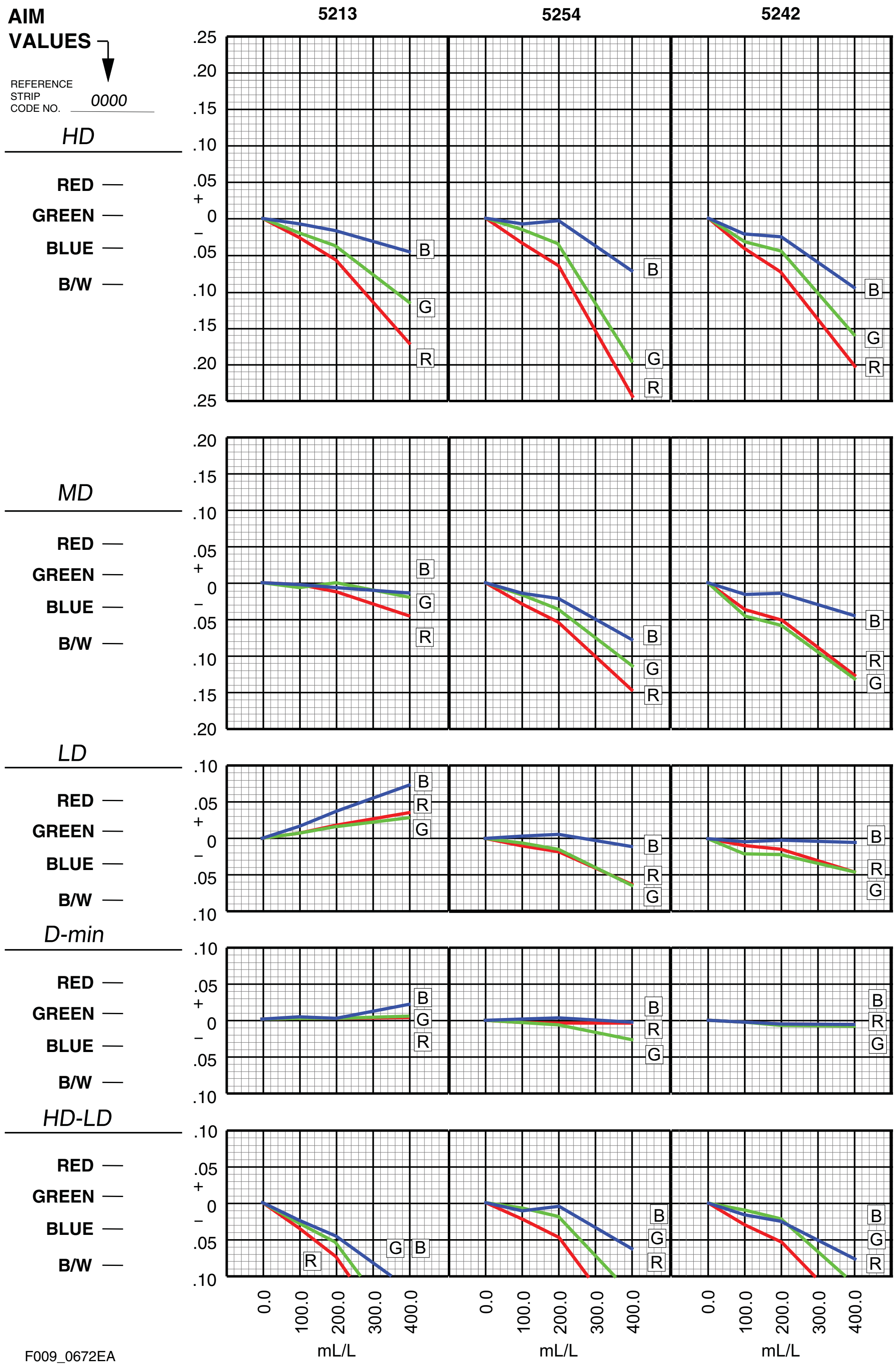
Developer Chemical Factors

Figure 8-9 Effects of KI Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



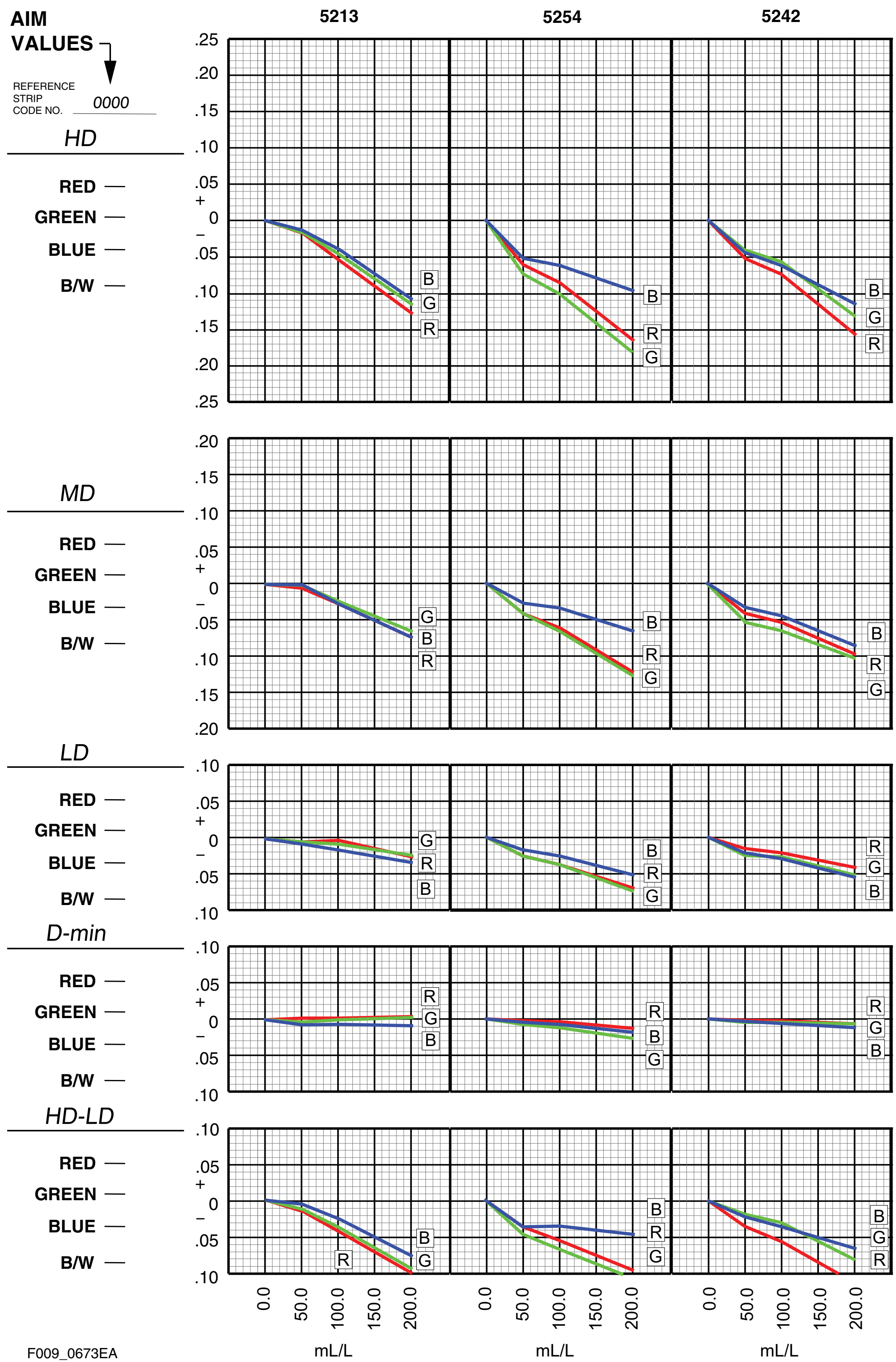
Developer Chemical Factors

Figure 8-10 Effects of Water Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



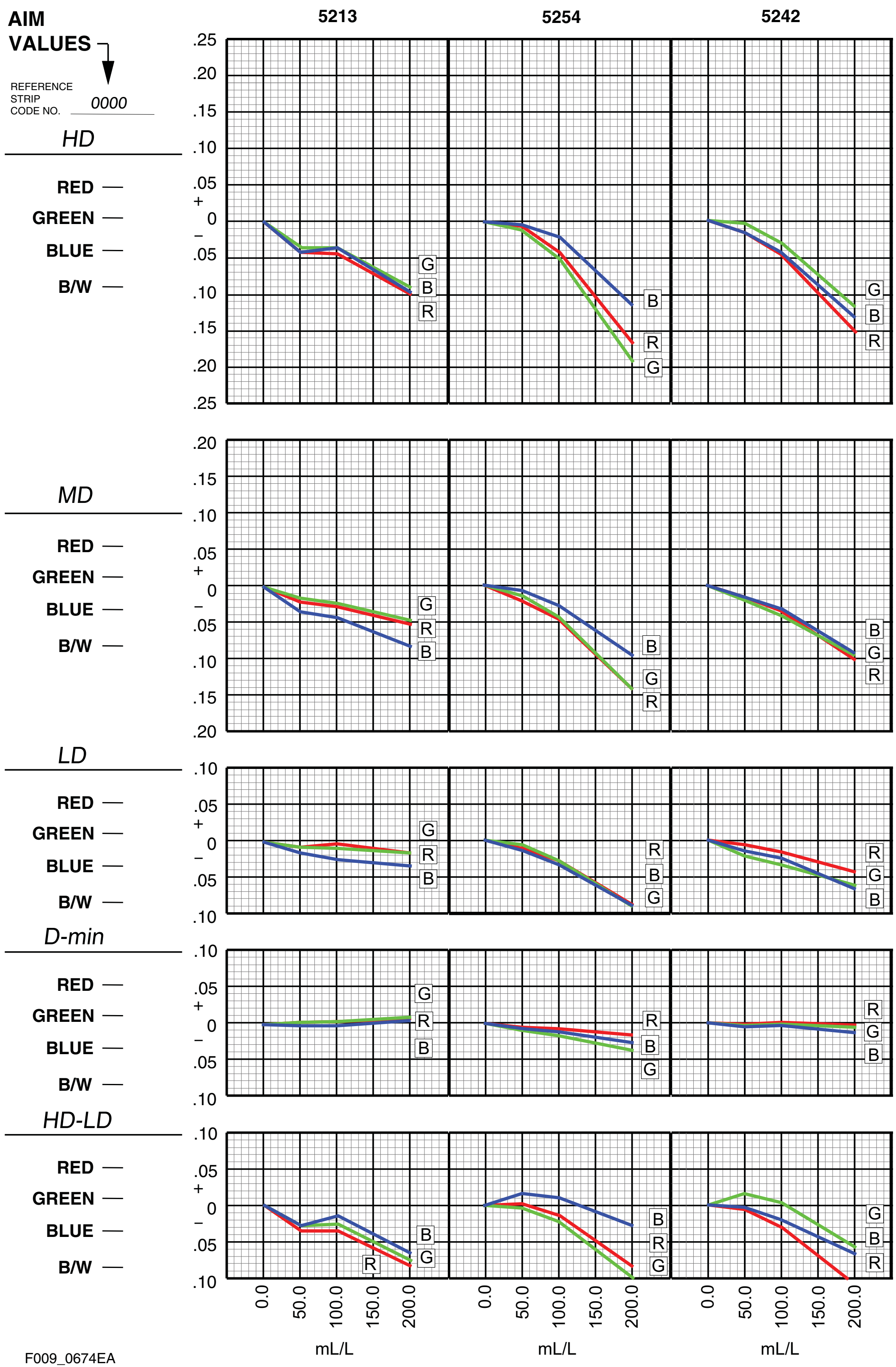
Developer Chemical Factors

Figure 8-11 Effects of Carbonate Prebath Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



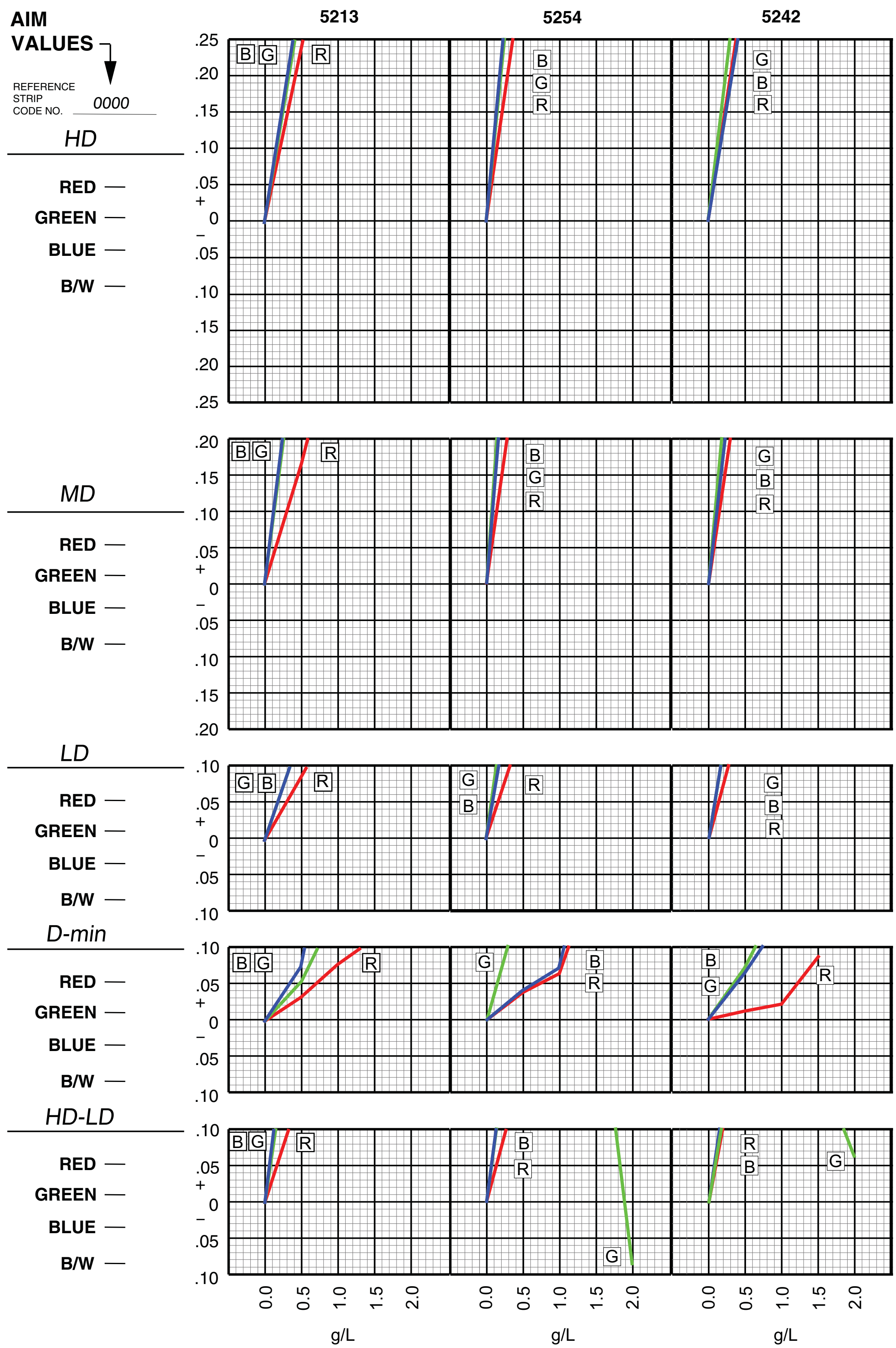
Developer Chemical Factors

Figure 8-12 Effects of PB-2 Prebath Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



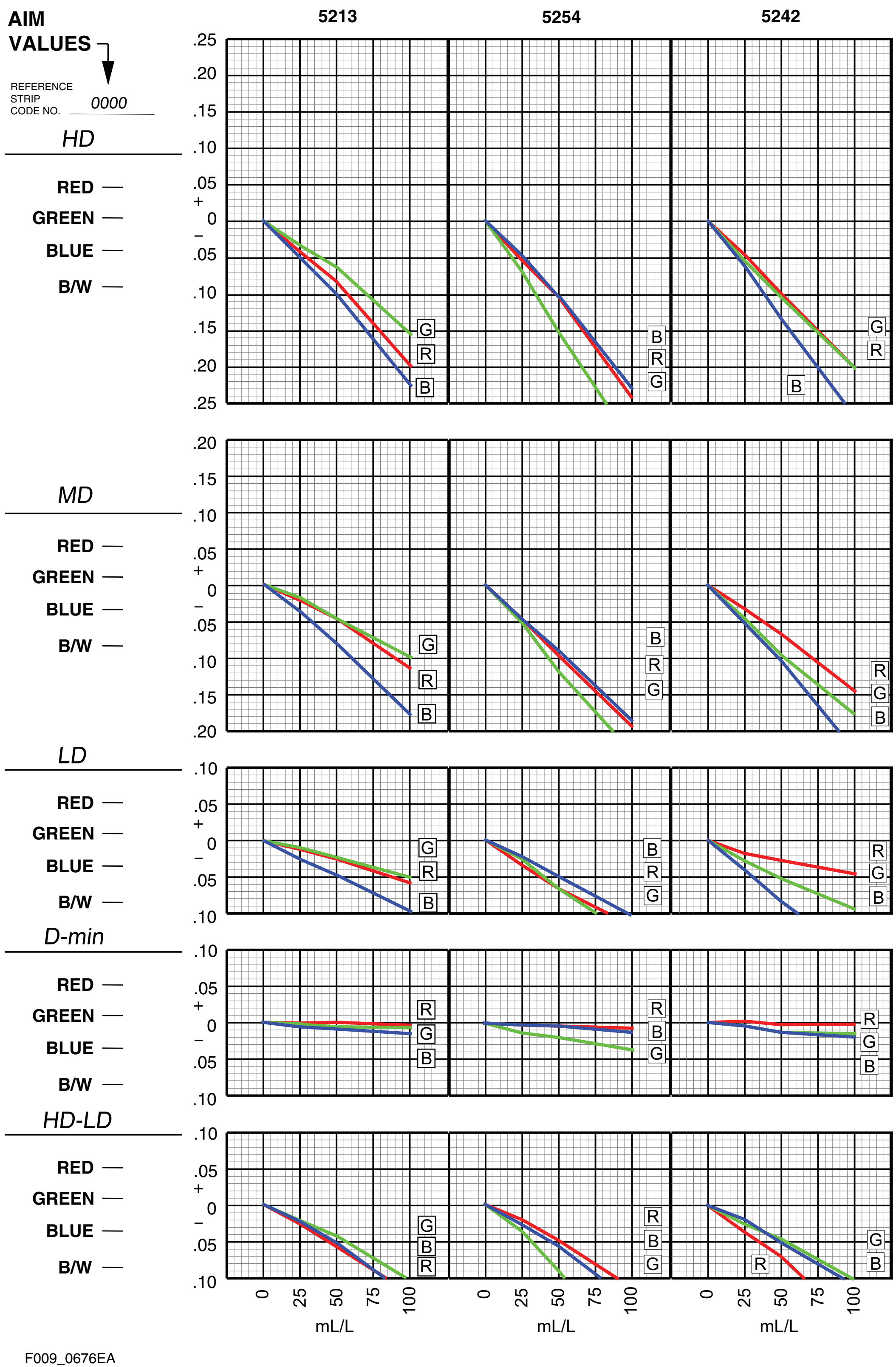
Developer Chemical Factors

Figure 8-13 Effects of CD2 / CD3 Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



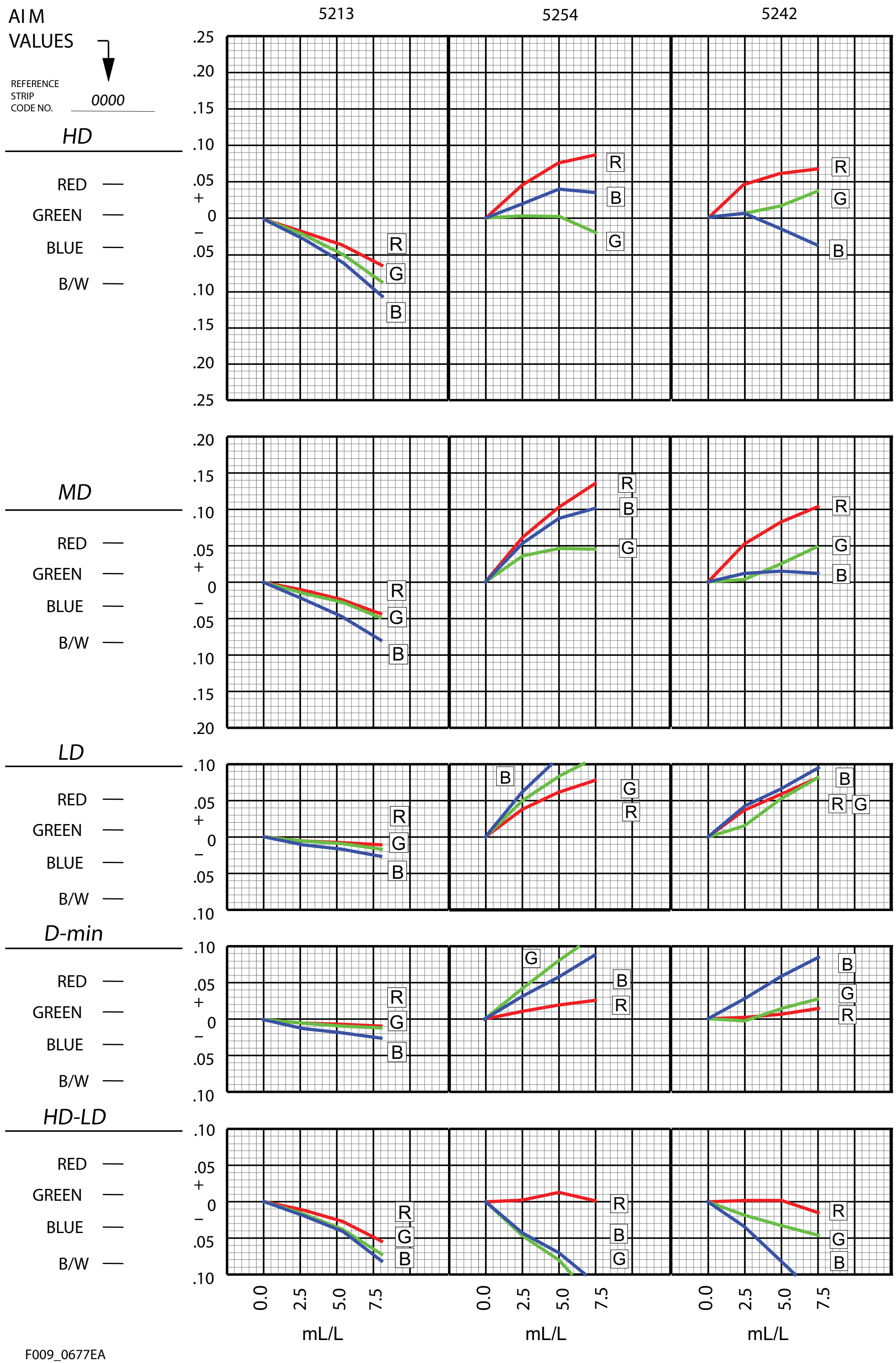
Developer Chemical Factors

Figure 8-14 Effects of Stop Bath Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



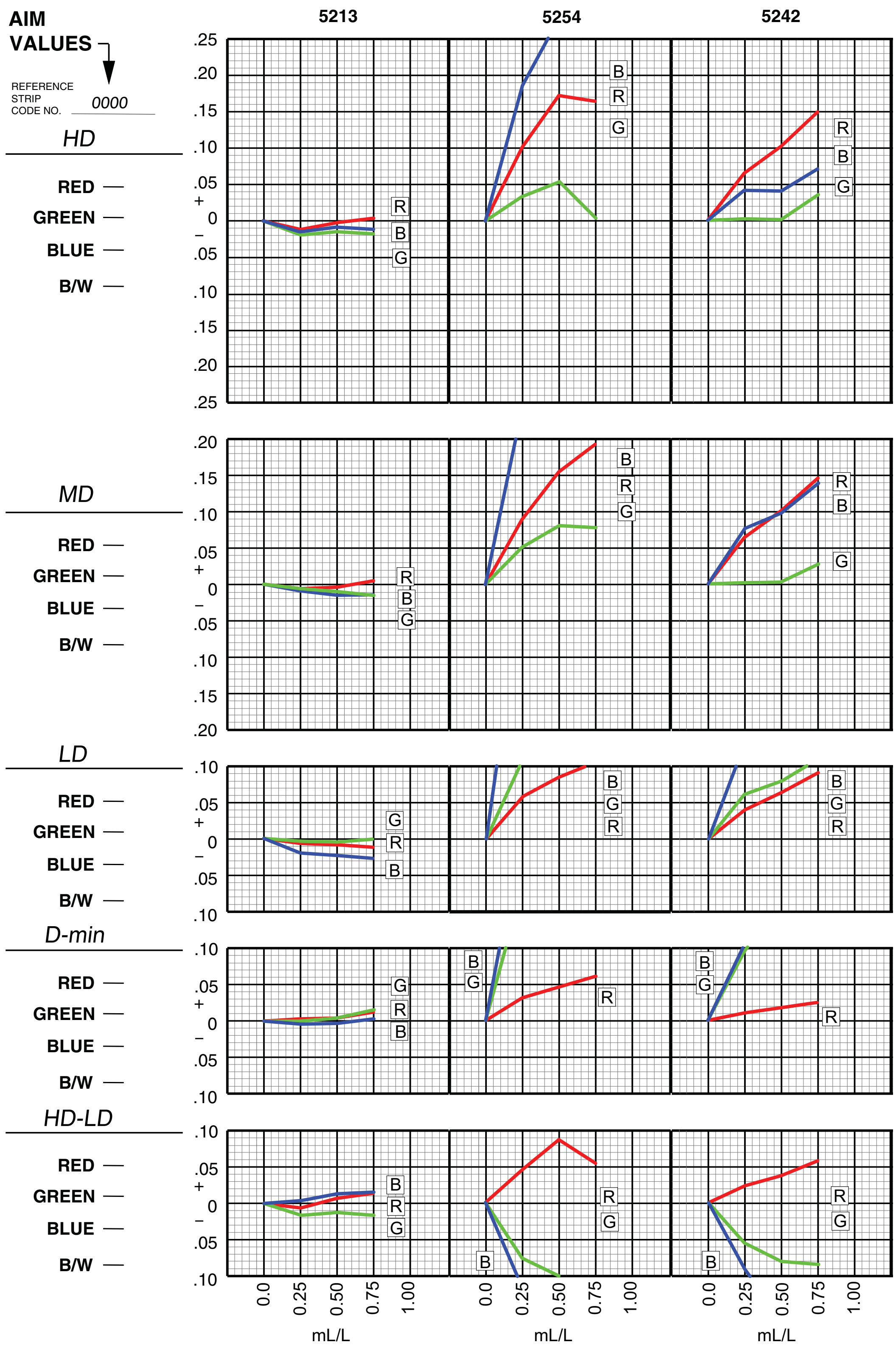
Developer Chemical Factors

Figure 8-15 Effects of UL Bleach Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



Developer Chemical Factors

Figure 8-16 Effects of Fixer Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



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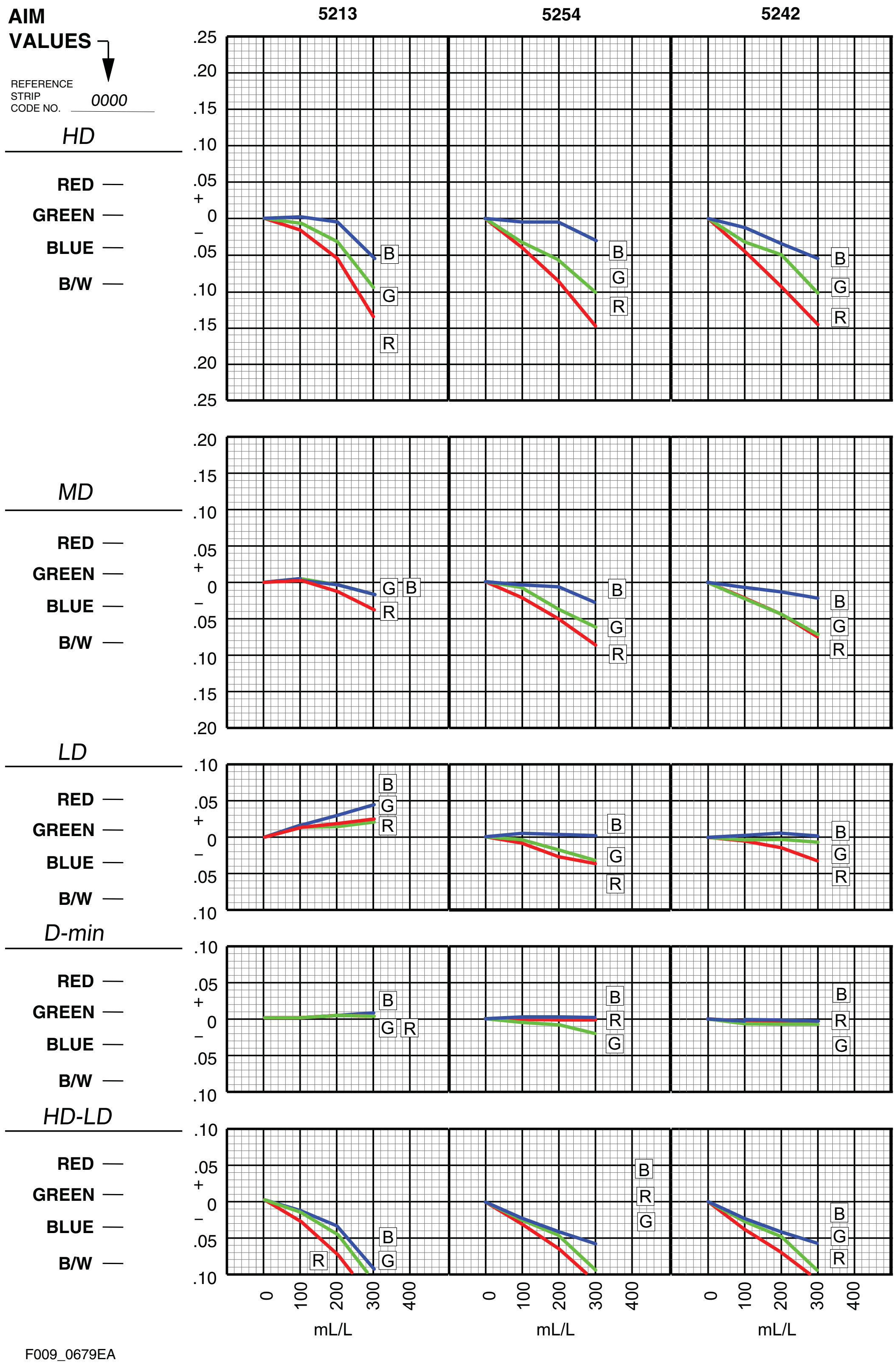
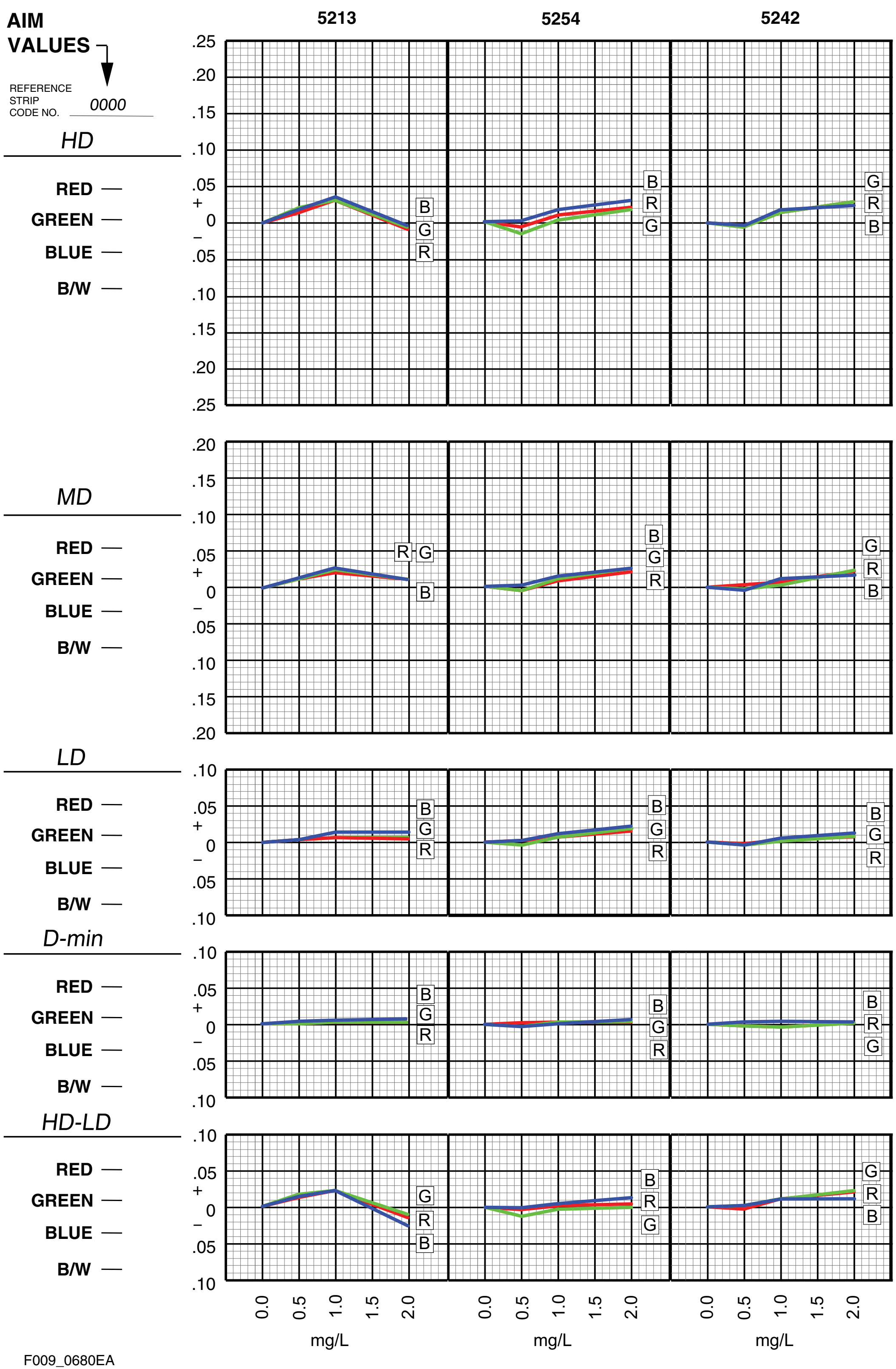
Developer Chemical Factors

Figure 8-17 Effects of Final Rinse Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



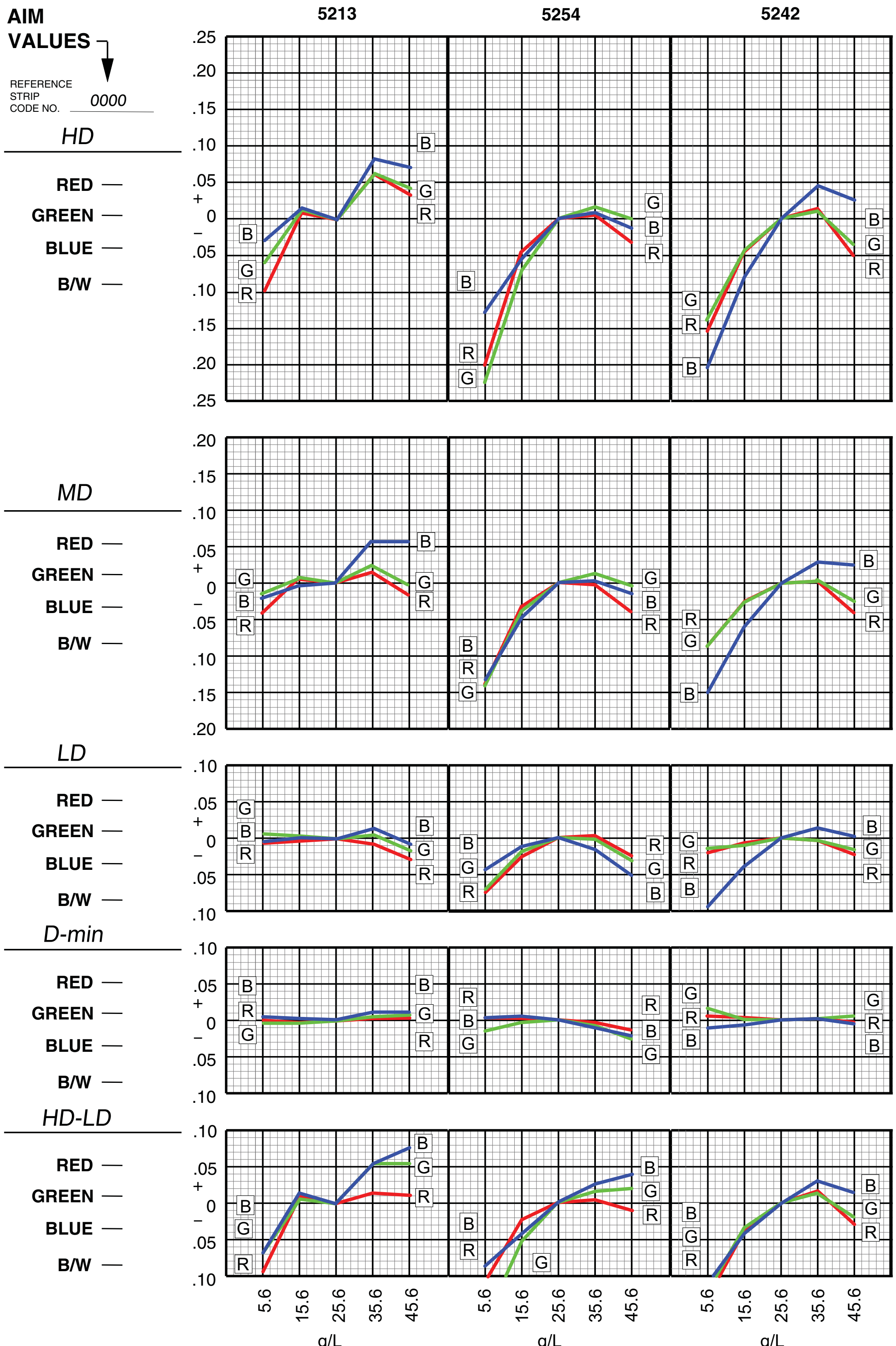
Developer Chemical Factors

Figure 8-18 Effects of Bacterial Na_2S Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



Developer Chemical Factors

Figure 8-19 Effects of Na_2SO_3 Contamination—5213, 5254, and 5242 Films in Process ECN-2 Developer



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DIAGNOSTIC SCHEMES

Color Negative Film Diagnostic Charts

The flow chart procedures illustrated in this section will aid in determining the source of an out-of-control process. There are eight major schemes:

- Figure 8-11 *Verification Process*
- Figure 8-12 *Problem Sorting*
- Figure 8-13 *Low Developer Activity*
- Figure 8-14 *High Developer Activity*
- Figure 8-15 *High D-min (Blue Only)*
- Figure 8-16 *Retained Silver (Ferricyanide and UL Bleaches)*
- Figure 8-17 *Retained Silver (Persulfate Bleach)*
- Figure 8-18 *Retained Silver Halide*

Figure 8-20 Verification Process

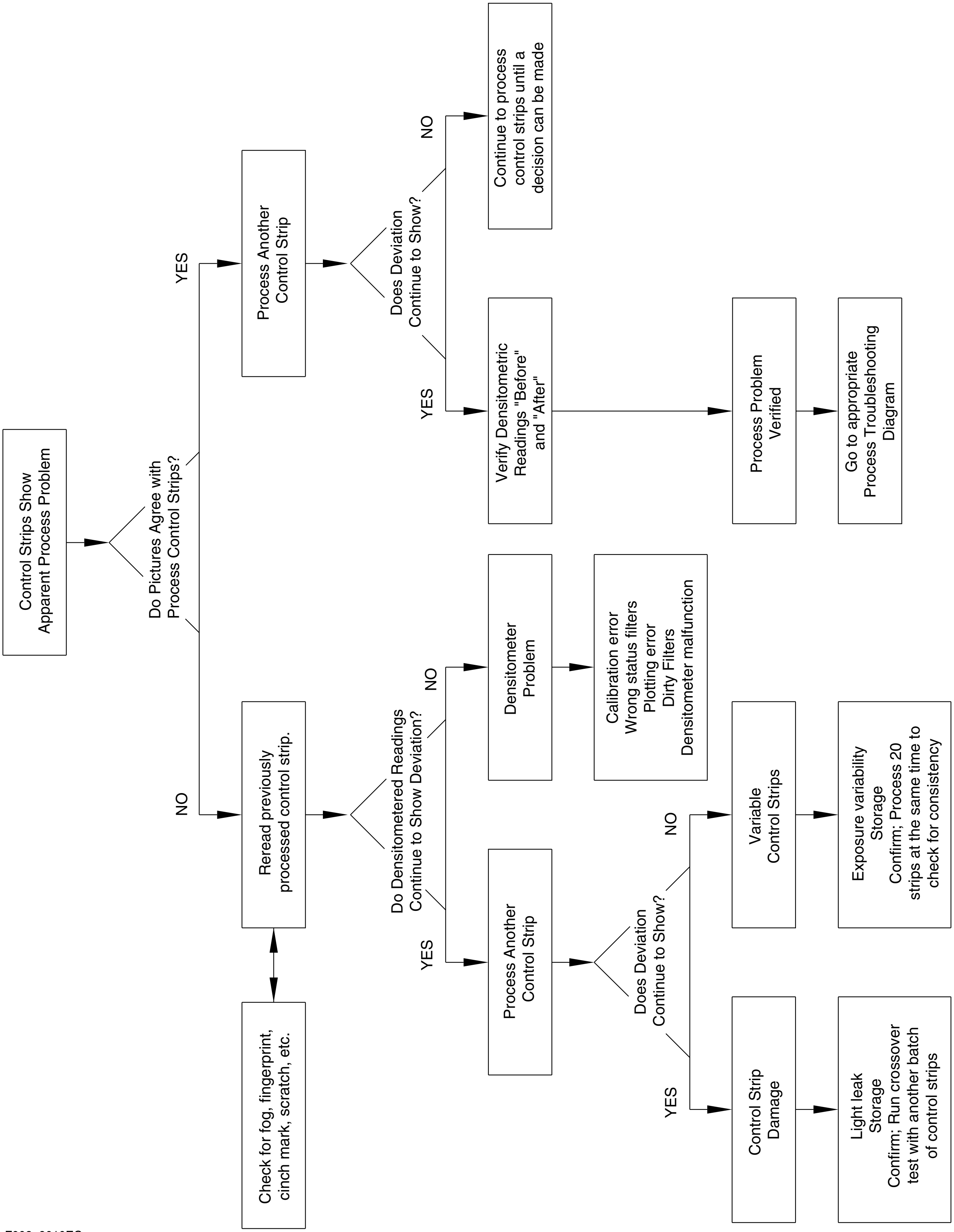

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Figure 8-21 Problem Sorting

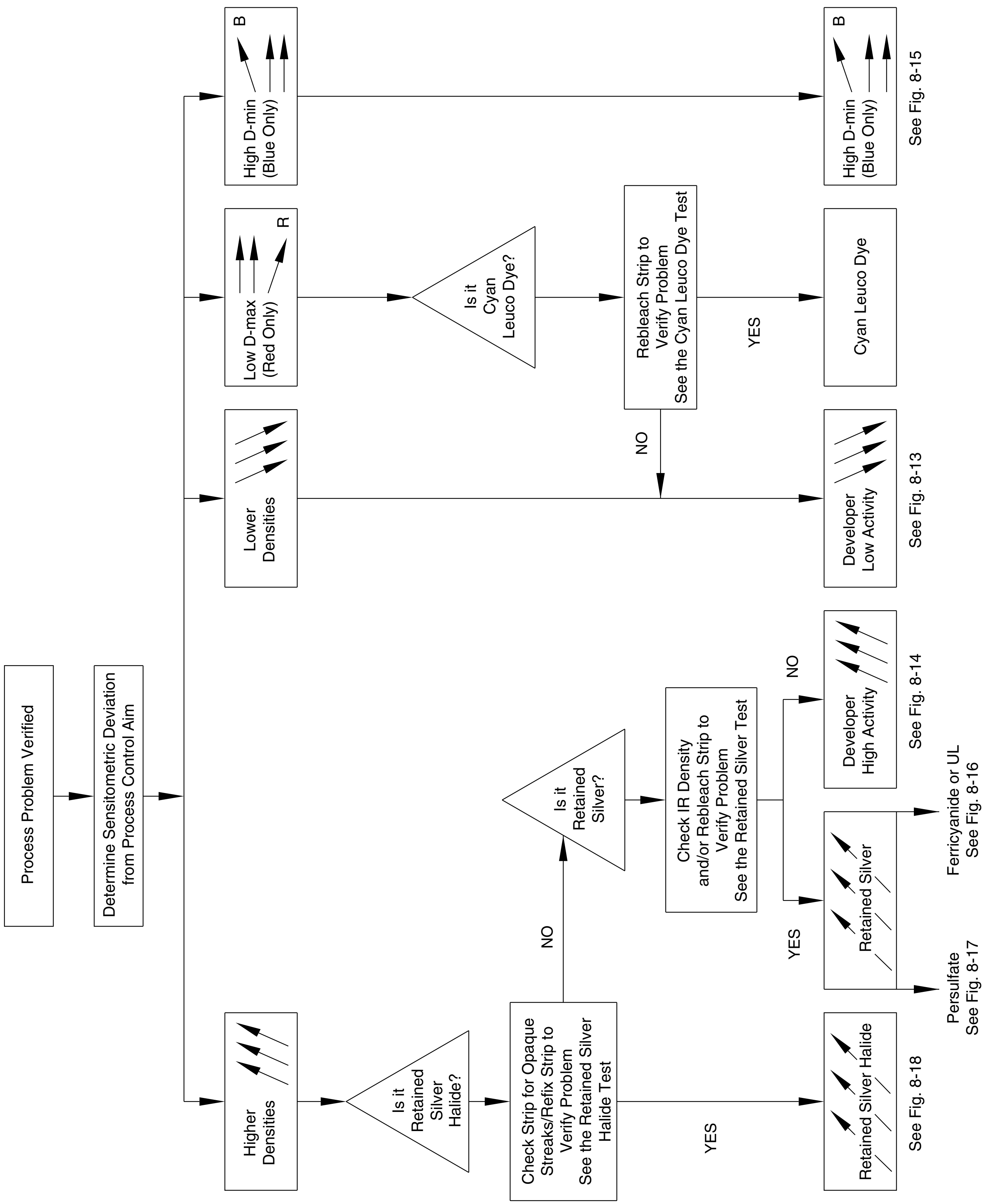

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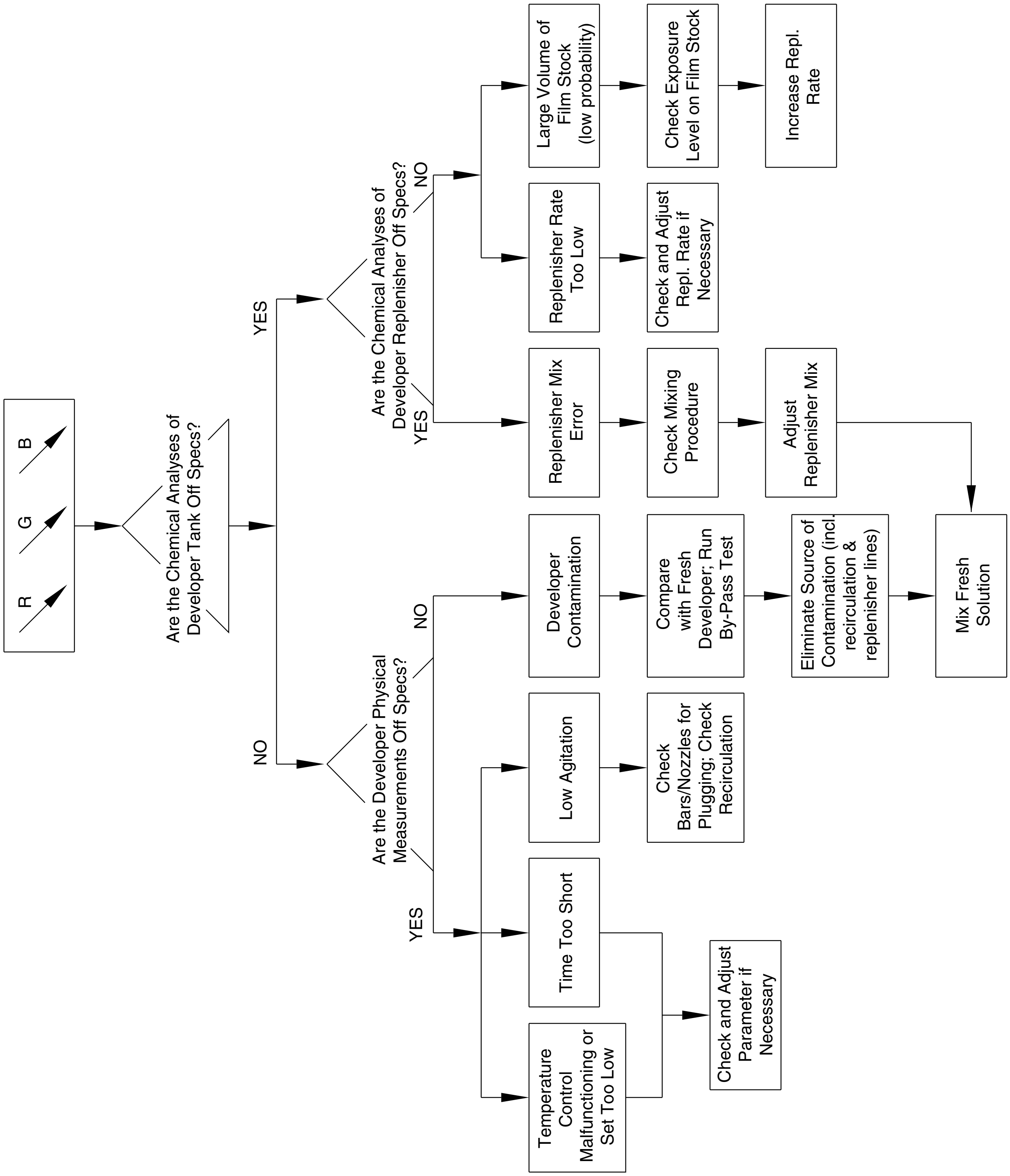
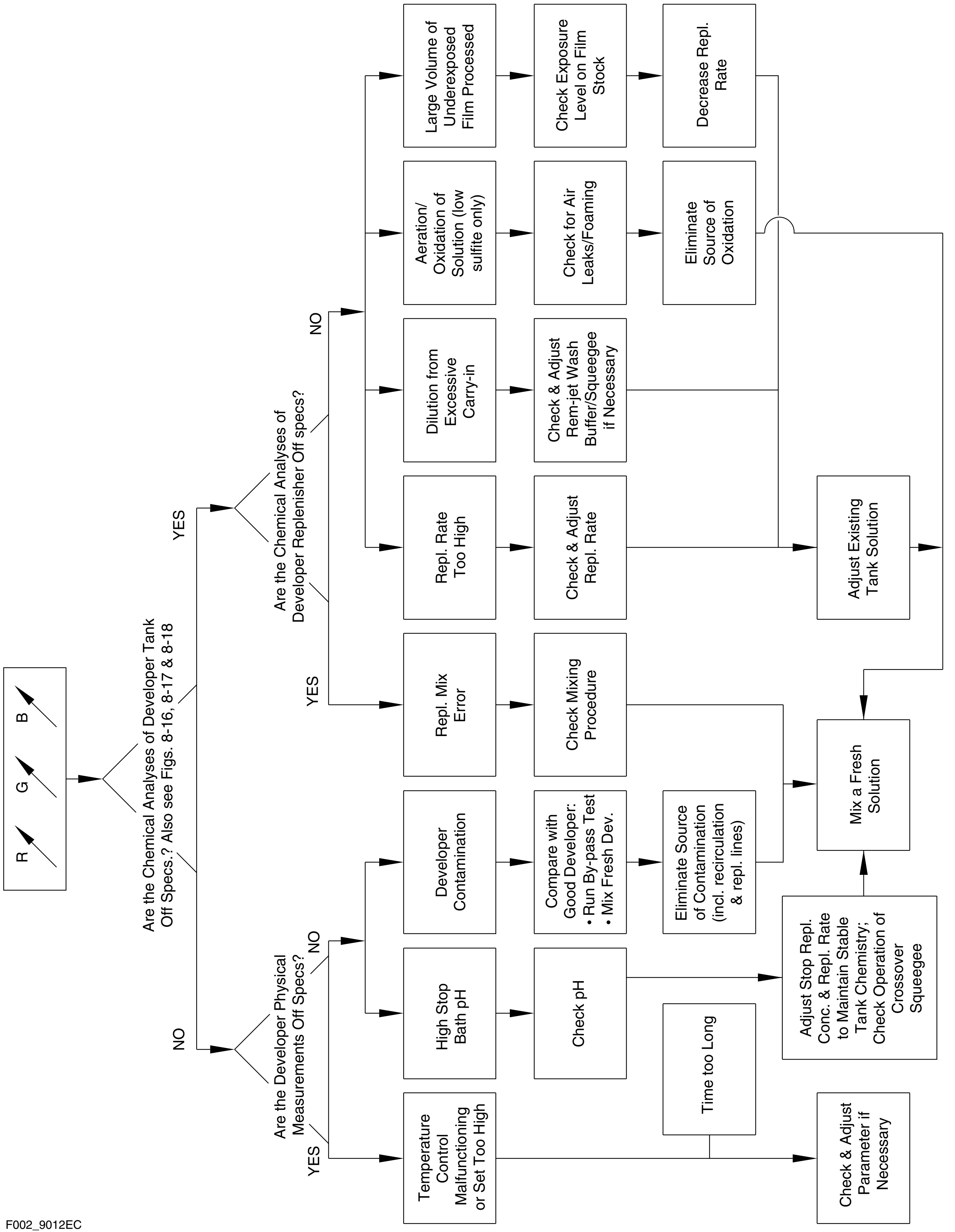
Figure 8-22 Low Developer Activity



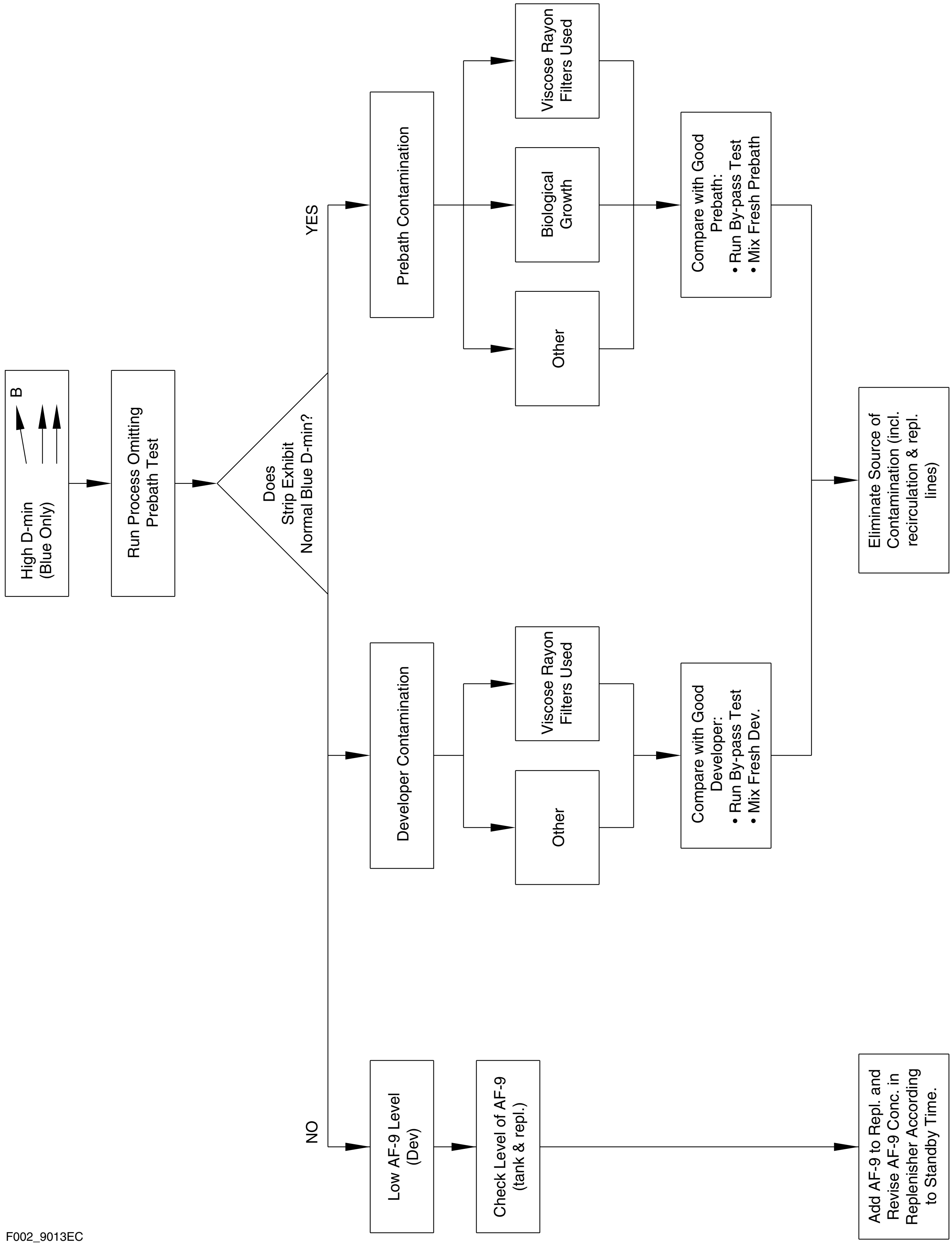
F002_9011EC

Figure 8-23 High Developer Activity



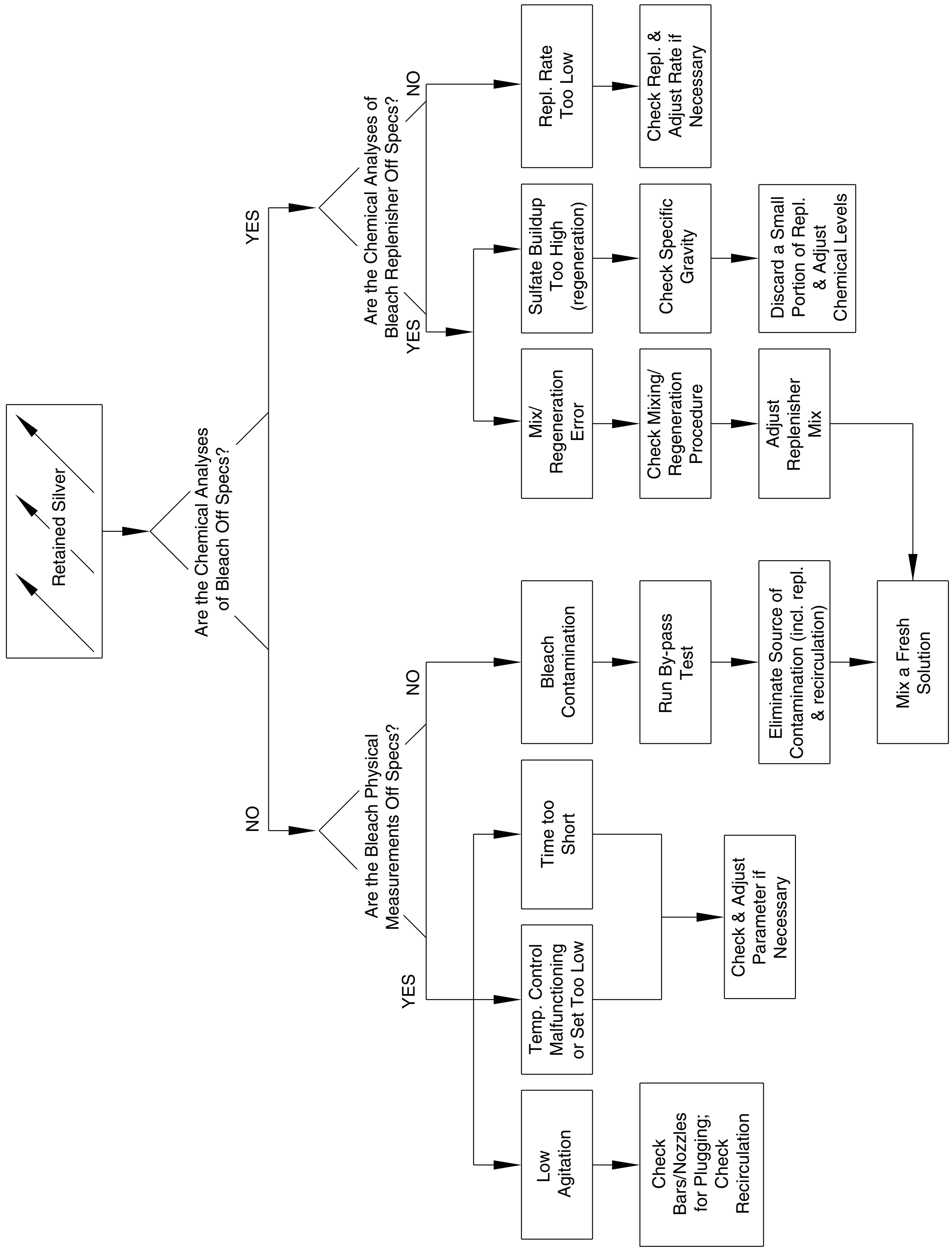
F002_9012EC

Figure 8-24 High D-min (Blue Only)



F002_9013EC

Figure 8-25 Retained Silver (Ferricyanide and UL Bleaches)



F002_9014EC

Figure 8-26 Retained Silver (Persulfate Bleach)

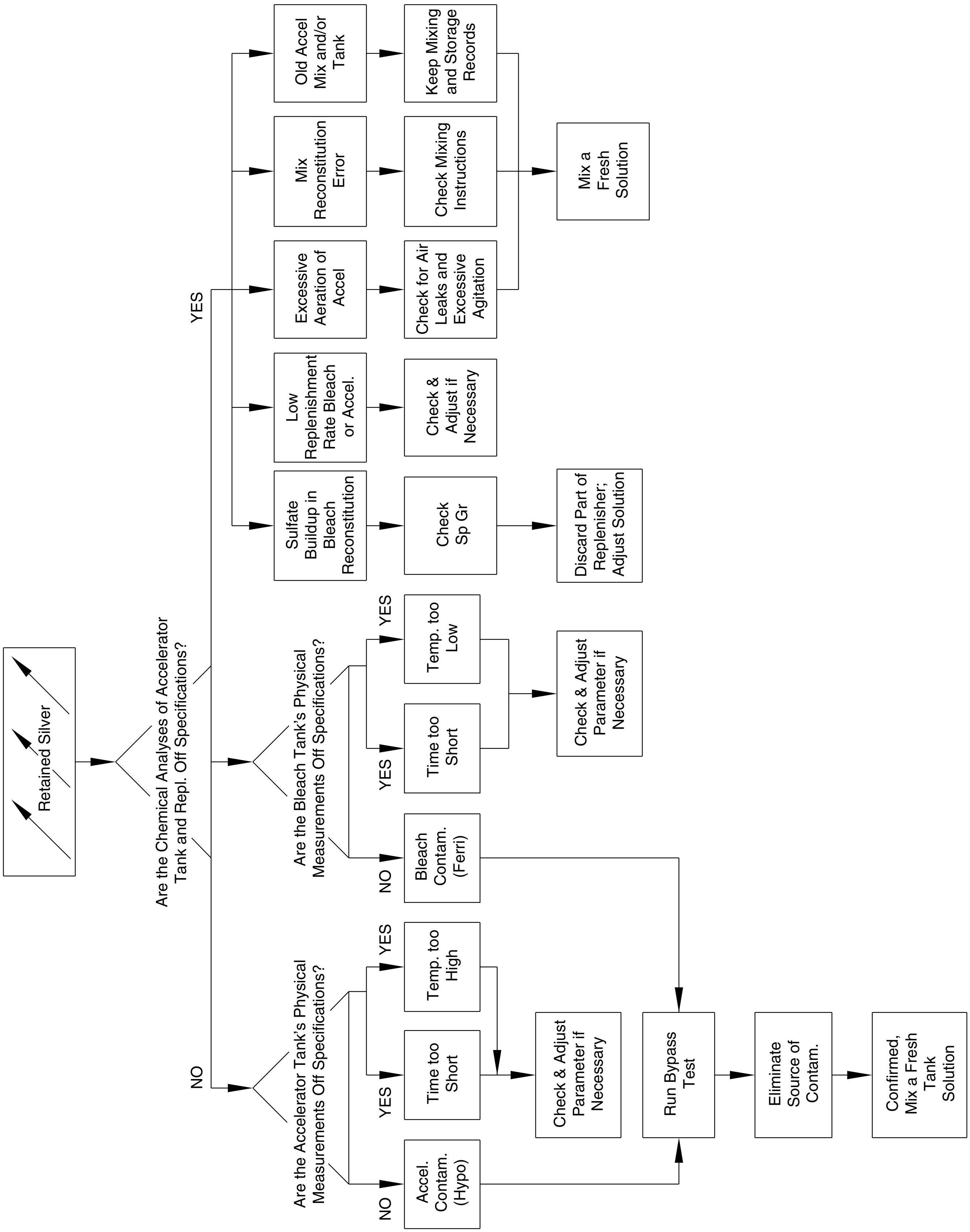


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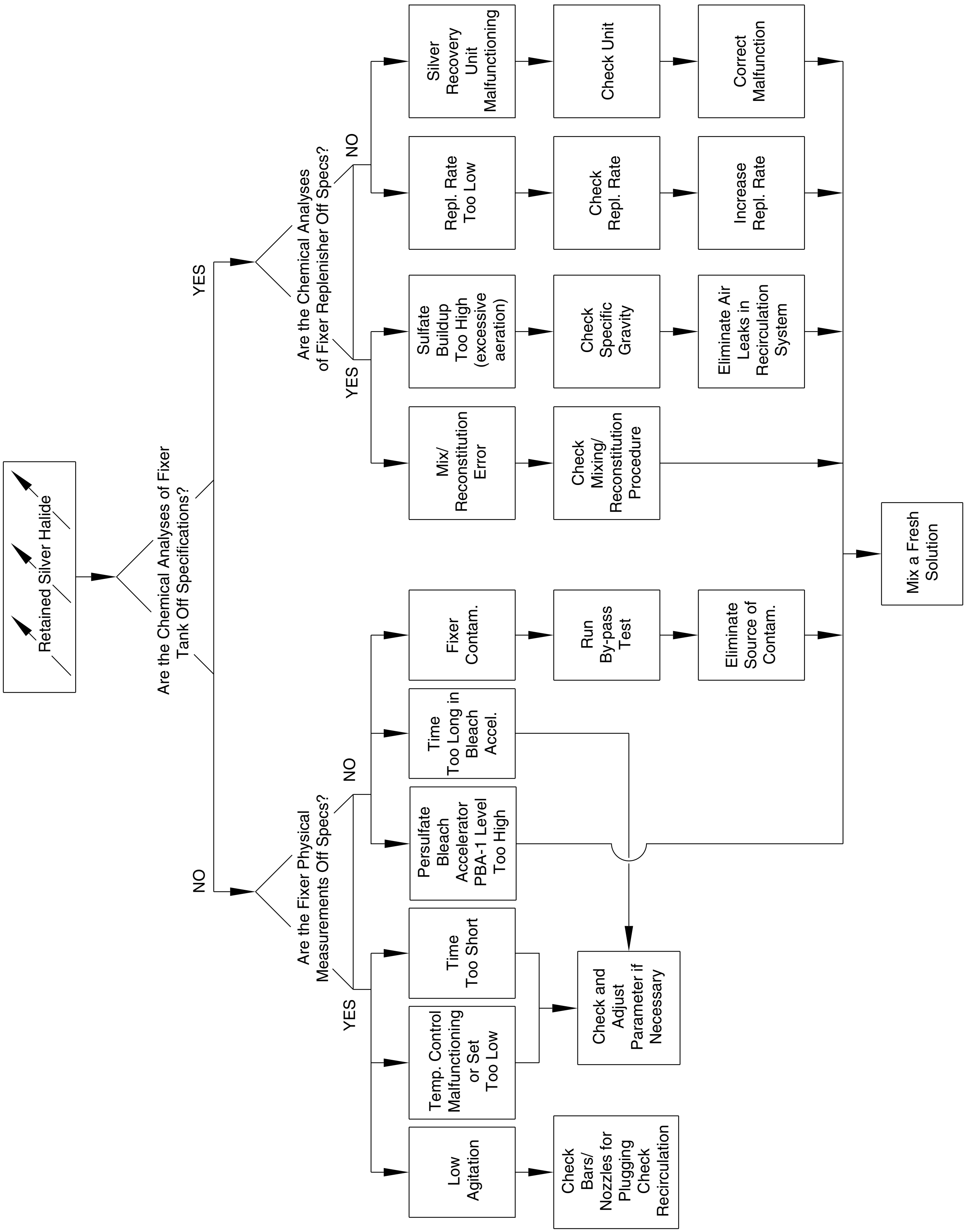
Figure 8-27 Retained Silver Halide



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SPECIAL TESTS

Introduction

This section explains how to run the following special tests mentioned at various places in the Diagnostic Charts:

- *Retained Silver Test*
- *Retained Silver Halide Test*
- *Cyan Leuco Dye Test*
- *Solution By-pass Test*
- *Process Omitting Prebath Test*

Retained Silver Test

Retained silver is the result of ineffective bleaching. The symptoms are:

- Increased density in the high-density areas of the film, particularly D-max, with no changes in lower densities (such as D-min). It may be seen as increased contrast.
- The infrared density of the D-max patch increases. Normally, an infrared density (at 1,000 nm) of less than 0.07 is acceptable, between 0.07 and 0.14 is marginal, and greater than 0.14 is unacceptable. A sound track densitometer is a suitable instrument for this measurement.

Verification Test:

1. Prepare a small volume of fresh bleach, or use a known good solution of bleach replenisher.
2. Immerse the processed film with suspected silver retention in the bleach for 1 to 2 minutes. Agitate by moving the film strip manually. Wash the film for 30 to 40 seconds under running water.
3. Fix the strip for 1 to 2 minutes in a small volume of a good fixer solution, again agitating manually. Wash the film for 30 to 40 seconds.
4. Dry the film and reread the infrared density. An infrared density within the acceptable region (which had formerly been marginal or unacceptable) confirms silver retention. Lower optical densities also confirm retained silver.

Retained Silver Halide Test

Retained silver halide is the result of ineffective fixing. The symptoms are:

- There are large increases in density (i.e., greater than + 0.10 R, G, and B) in both the D-min and D-max steps of the control strip. The overall contrast is only slightly increased.
- The infrared density of the D-max patch is normal. Normally, an infrared density (at 1,000 nm) of less than 0.07 is acceptable, between 0.07 and 0.14 is marginal, and greater than 0.14 is unacceptable. A sound track densitometer is a suitable instrument for this measurement.
- Opaque streaks are generally visible when the strip is viewed with reflected light.

Verification Test:

1. Re-fix the processed control strip for 1 to 2 minutes in a small volume of a fresh fixer replenisher solution or known good fixer replenisher. Agitate by moving the film manually. Wash the film for 30 to 40 seconds under running water.
2. Dry the film and reread the densities. If the D-min and D-max readings are down to normal control levels after refixing and/or the opaque streaks disappear, the problem can be attributed to retained silver halide.

Cyan Leuco Dye Test

Cyan leuco dye is a colorless form of cyan dye. The sensitometric effect is exclusively in the red layer, with the red D-max being lowered by as much as 0.30 units. In Process ECN-2, the effect on cyan dye results in artificially low red contrast. Leuco dye can be produced by several fixing or bleaching conditions.

Extended fix time (longer than 4 minutes) or high-current density in on-line silver-recovery cells can cause leuco dye in Process ECN-2. The extended fix time is not likely to occur unless the film has been stopped in the fix tank. The leuco dye can be converted into its colored form by reprocessing through a fresh bleach.

Verification Test:

1. Re-bleach the suspected strip in a small volume of fresh bleach for 2 to 3 minutes. Agitate by moving the film strip manually. Wash the film for 30 to 40 seconds under running water.
2. Dry the strip and reread the red D-max step. If the red D-max is raised to its normal control level by re-bleaching, the problem is verified since the cyan leuco dye is converted back to its colored form.

Solution By-pass Test

Use this test to check out any processing solution when it is suspected of causing a photographic deviation. It is particularly useful in avoiding unnecessary dumping of a suspected processing solution. Although the test is often used with secondary solutions, it can also be used to check out prebath and developer problems if an adequate "sink-line" process (i.e., with a controlled temperature bath) is available. The test procedure is outlined below

1. Obtain a sample of the suspected solution.
2. Mix a fresh sample of the solution in question or use a known good solution of the same type, i.e., from another processing machine.
3. In a sink-line process, run one set of control strips through the suspected solution, and the other set through the known good solution. Use normal processing times and temperatures. If possible, process both sets together at the same time. Use the same solutions for both sets of strips for all other processing steps.

   Note: For secondary solutions, strips can often be processed in the machine up to the point in question. After cutting out the strip at the crossover, proceed as described above in a sink-line process. The strips may be spliced onto machine leader at the exit of the suspected solution and processed together for the remaining steps.
4. Compare the photographic results from the suspected solution and the known good solution. If the set of strips processed in the suspected solution deviates in the same direction as the actual photographic deviation, the suspected solution is causing the photographic effect. If the results between the two solutions are similar, the test can be repeated checking the other processing solutions, one at a time.

   Note: Since sink-line tests may not give exactly the same results as machine runs, it is important to look at the difference between the sets of strips, even if they do not exactly match normal control strips.

Process Omitting Prebath Test

This test can be used to help indicate the source of development-related high blue D-mins in Process ECN-2.

1. Process a strip of KODAK VISION Color Negative Film omitting the prebath. This can be done right on the film processor by skipping the prebath rack.

   Note: The rem-jet backing can be removed manually either before or after processing, using a plush pad and denatured alcohol.
2. Read the D-min of this film with a densitometer and compare the results with the D-min of a normally processed strip.
3. Results/Action:
   a. If high blue D-mins persist, check the developer for contamination.
   b. If high blue D-mins become normal when omitting the prebath, check for prebath contamination.

PROCESSED FILM PROBLEMS

Problem	Appearance in the Film	Appearance in Projected Print or Telecine Transfer	Possible Source of Problem	Suggestion Corrective Action
Black lines and comets	Short, black lines and comets on emulsion surface. Shiny in reflected light.	Short, white lines and comets.	Under certain conditions, the electrolytic silver cell in the fixer recirculation systems produces small, flocculent silver flakes. These flakes get into the fixer tank, attach to the emulsion, and then go through the fixer squeegee, where each one is smeared into a line or comet.	Use a 10- to 15-micron filter in the fixer return line from the cell, or correct operation of the cell.
Curtains	Faint vertical streaks of non-uniform density.	Moving curtains in large uniform density areas.	Improper developer turbulation.	Follow specifications for turbulation coverage, pressure, and frequency.
Dirt particles	Dark spots and marks. Easiest to see under high-intensity specular lighting.	White spots or sparkle.	Dirt may consist of dust, cloth filaments, hair, skin flakes, chemical crystals, scum, etc. Such dirt can come from machine operators, air-conditioning units, incorrect construction materials, lack of solution or dryer air filters, water hardness, poor housekeeping.	Establish and follow good laboratory cleanliness procedures. For more information on laboratory cleanliness, refer to Module 2, *Equipment and Procedures*.
	Yellow particles on surface.	White spots.	Low fixer pH causes the formation of sulfur particles in the fixer.	Maintain the fixer pH within specifications.
Dots equally spaced apart, repeating	Film base deformed or emulsion marked.	Repeated showers of dots in which individual dots are always the same distance apart.	Soft touch tire riding on the emulsion during processing.	Be certain the emulsion does not ride on spools with soft-touch tires.
			Film stopped in the dryer and distorted by heat where touching the tire.	Do not stop film in dryer.
			Film twisted before dryer.	Correct twist.
Edge marks	A cyan-edged dark scallop on the film edge. Repeats at frequency of roll circumference, decreasing in size as roll unwinds.		Dropping roll of unexposed film onto hard surface.	Handle film with care.
Emulsion skivings	Small particles of emulsion sheared from the film edges and deposited on the film surface.		Spools improperly aligned, or with burrs.	Check the machine spools.
Ferrotyping	Irregular, shiny areas on the emulsion surface.		Wet or tacky emulsion at windup.	Adjust the dryer to provide adequate film drying.
			High windup tension on unprocessed films.	Reduce the windup tension.
			Unwinding and rewinding unprocessed cold film without allowing it to reach room temperature first.	Always allow adequate time for film to come to room temperature before using in camera or re-winding for inspection.
Fine streaks	Faint vertical streaks.	Sharp-edged streaks and lines apparent in uniform density areas.	Worn or misaligned wiper-blade squeegee.	Check and align squeegees.
Fungus or algae deposits	Irregular smears, streaks, and spots.	Smears, streaks and spots.	Fungi and algae tend to form on the inside walls of the wash tanks. Their presence is indicated by a slippery and slimy feel to the tank walls.	A 5 1/4 percent solution of sodium hypochlorite, available as household bleach (e.g., Clorox), can be used to clean the tank in order to control the formation of fungi and algae. See "Control of Biological Growths," in Module 2, *Equipment and Procedures.*

Problem	Appearance in the Film	Appearance in Projected Print or Telecine Transfer	Possible Source of Problem	Suggestion Corrective Action
Fuzzy spots	Faint fuzzy spots.	Soft-edged, low-density spots in uniform areas of moderate density.	Air bubbles in Process ECN-2 washes, causing nonuniform swelling of the negative emulsion and creating lens-like depressions. Mixing hot and cold water releases air from the cold water, producing very tiny air bubbles.	Allow tempered wash water to stand in a supply tank before use. Add to the top, and remove from the bottom of the wash tanks, or run the tempered wash water through a horizontal coil of very large hose (inner diameter of 2 inches or more) before the wash tank. Any of these measures should reduce the amount of air bubbles in the wash tanks.
Magenta stain	Magenta density increase.		Several rewashings of camera films in RW-1 produces increased magenta density.	Green light printer exposure may have to be adjusted if film has been rewashed.
			Stop with low replenishment rate, excessive developer carry-over, or high pH.	Maintain recommended stop replenisher rate and pH.
			Excessive concentration of borax used in the bleach to control its pH.	Lower borax level to 1-2 g/L.
Newton's rings		Fuzzy, erratic, faintly colored lines.	High or uneven printer gate pressure.	Adjust printer.
			Low relative humidity in printing room.	Raise relative humidity to 60 percent.
			Preprint film was dried too fast or over dried.	Adjust drying conditions of preprint film.
Pressure marks	Magenta marks.	Green marks.	Pressure on emulsion causing magenta layer fog.	Avoid holding, pinching, buckling, or pressing on the emulsion of unprocessed film.
	Yellow spots or blotches.	Blue spots or blotches.	Excessive pressure applied to the emulsion (e.g., soft-touch tire pressed on film by feedstand brake).	Eliminate all objects that put excessive pressure on the unprocessed emulsion.
Prussian blue	Blue dirt or scum.		Inadequate stop wash, causing low bleach pH (ferricyanide bleach only).	Be sure the wash rate is adequate to keep the pH of the final stage of the stop wash above 3.0.
Rem-jet contamination	Black areas, black flakes, or gray streaks on the film base or emulsion surface.	White images of the negative defects.	A prebath that is low in pH, temperature, or time less than required.	Check that prebath meets specifications.
			Maladjusted spray nozzles in the rem-jet removal equipment.	The pairs of nozzle sprays must strike the film simultaneously from opposite sides so that the water flow is across the film. The scouring action across the base removes the rem-jet backing and suspends it in water, while the spray across the emulsion side prevents any water laden with rem jet from reaching the emulsion surface before it leaves the strand. The nozzle pairs must be balanced in direct opposition, with the correct speed and flow across the strand to prevent the rem jet from migrating around the edge of the film or through the perforations onto the emulsion surface. Rem jet is not easily removed from the emulsion surface.

Problem	Appearance in the Film	Appearance in Projected Print or Telecine Transfer	Possible Source of Problem	Suggestion Corrective Action
Reticulation	Rough emulsion surface.		High solution temperatures.	Adjust to specifications.
			High wash temperatures.	Adjust to specifications.
			Dryer temperature too high or relative humidity too low.	Adjust to specifications.
Scalloped or fluted edges			Excessive tension on the film strand.	Check the processing machine for excessive tension in the film loops caused by a high rack or improper machine drive. Check for improper threading. Rectify either condition.
Scratches	Light lines running length-wise on the film.	Dark lines running length-wise on the film.	Deposits on rem-jet buffer.	Install a buffer-cleaning nozzle, and replace the buffer roller regularly. Water from the cleaning nozzle must not run onto unsprayed rem jet. KODAK Anti-Calcium, No. 4, or equivalent, in the prebath prevents the precipitation of calcium or magnesium salts.
			Old, hard, worn, crystal-laden, or maladjusted wiper-blade squeegees.	Use spring-loaded wiper blade squeegees of 40-durometer hardness or less. Keep them clean, and replace them when worn.
			Cinching a roll of film before or after processing.	Be certain that the machine take-up does not jerk the film roll. Train film handlers in proper film rewinding techniques.
			Improper loading of camera magazine or processing machine.	Always handle film with care. Examine cameras and equipment for sharp edges, burrs, etc, and eliminate them.
			Machine spools that are not rotating freely or are out of line.	Check spools regularly, and replace bearings when necessary.
			Chemical crystals or other foreign material on spools.	Spools and racks should be cleaned regularly according to the procedures in the machine maintenance section of this manual.
			Improper machine threading (a twist in the film) or improper splices.	These problems should be corrected according to normal processing procedures.
Shoreline	In specular reflected light shoreline appears as lines around perforations and/ or running lengthwise on the film.	Fuzzy contour lines at the sides of projection aperture.	Nonuniform or too rapid drying of the film emulsion.	Reduce the temperature, or increase the relative humidity of the air in the drying cabinet.
Static marks	Yellow spots and dots.	Blue spots and dots.	Rapid rewinding or transporting film in low relative humidity.	Unprocessed film should not be rewound at high speed. The relative humidity in the rewinding area should be 50 percent or greater.
			Emulsion contact with flat non-conducting rollers before processing.	Only undercut rollers should come in contact with the emulsion surface. Use conductive materials on the rewind, load accumulator, etc, and ground them.

Problem	Appearance in the Film	Appearance in Projected Print or Telecine Transfer	Possible Source of Problem	Suggestion Corrective Action
Tacky film			Inadequate final film squeegee action.	Check the air flow, alignment and cleanliness of the final squeegee.
			Inadequate drying conditions.	Check the temperature, relative humidity, and flow rate of the air in the dryer cabinet. The heaters or the fan may not be functioning properly, or the air filters may be plugged with dirt. If the dryer uses recirculated air, be sure it is mixed with incoming air. Also check the humidity control of recirculated air. If the film is still tacky after all possible normal corrective measures have been taken, as a temporary measure, increase the temperature of the dryer air. Because increased air temperature can be injurious to the film, such action requires close attention to the physical appearance of the film.
Water spots	Irregular areas on emulsion surface best seen in specular reflected light.	Spots, streaks, and run marks.	Lines, drops, or puddles of water allowed to enter the dryer on the film.	The final squeegee in the process must be very efficient and must remove virtually all water from the emulsion surface.
Yellow fog	Yellow highlights.	Blue shadows.	A low-level light leak in the dark section of the machine (e.g., from luminous clocks or night lights).	Remove all sources of light that shine directly on unprocessed films.
Yellow stain	Yellow highlights.	Blue shadows.	See Diagnostic Scheme, Figure 8-15 *High D-min (Blue Only)* for contamination of developer by sodium thiocyanate (VNF-1 first and color developer, or Reversal Agent RA-1).	Use care to avoid developer contamination of any kind.

Processing KODAK Motion Picture Films, Module 8
Effects of Mechanical & Chemical Variations in Process ECN-2

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