

# 5 PROCESS MONITORING AND TROUBLESHOOTING

To produce high-quality color negatives consistently, you need to match your process to a standard for density, color, and contrast each time you process film. In addition to monitoring process parameters such as solution times, temperature, replenishment rates, solution concentrations, etc., you should regularly run control strips to ensure best results.

This section describes standards and methods for setting up your process and for ongoing process monitoring. The primary tools for monitoring your process are KODAK Control Strips, Process C-41, and the reference strip. This section describes how to use these strips and interpret the results.

## PROCESS-MONITORING TERMS

The following terms are frequently used in process monitoring.

**Action Limits**—The action limits are the boundaries of the aim operating range of the process. As long as the control-strip density values remain between the upper and lower action limits, your process is operating correctly. If a density value exceeds the action limit, it is an “early warning.” You can still process customer work, but you should check for the cause of the shift and correct it. When the density values plot between the upper and lower action limits (within the “aim zone”), your process is in control.

**Aim Values**—You compare your control-strip density readings to these values. To obtain aim values, read the reference-strip densities; then apply the correction factors (supplied with the control strips and reference strip) to those density readings. Enter the aim values in the spaces provided on the left side of your control chart.

**Color-Balance Spread Limits**—A color spread is the density difference between the two most widely separated densities of the HD – LD plot. If your process exceeds the color-balance spread limit, stop processing customer work, and take corrective action.

**Control Limits**—The control limits define the maximum tolerances that are acceptable for processing customer work. If any density value of your process plots beyond the control limit, the process is out of control. Results will be unsatisfactory for color, density, or contrast. When any density value plots beyond the control limit, stop processing customer work until you find the cause of the shift and correct it.

**Control Strips**—These are precisely exposed strips used to monitor your process.

**Correction Factors**—Use these numbers to adjust the densities of the reference strip to obtain aim values. They are printed in the instruction sheet packaged with each box or roll of control strips. *Correction factors are issued for each code number.*

**Reference Strip**—This is a control strip that has been precisely exposed and processed by Kodak under standard conditions. A reference strip is packaged with each batch of control strips. To obtain aim values, measure the reference-strip densities and apply the correction factors for that batch of control strips.

**Tolerances and Limits**—These are density variations permitted before you must take corrective action. They include an aim-value adjustment tolerance, and action and control limits. The tolerances and limits listed in Table 5-1 apply to KODAK Control Strips, Process C-41.

**Table 5-1 Tolerances and Limits for KODAK Control Strips, Process C-41**

Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits	Color-Balance Spread Limit
D-min	± 0.03	+ 0.03	+ 0.05	NA
LD	± 0.04	± 0.06	± 0.08	NA
HD – LD	± 0.03	± 0.07	± 0.09	0.09
D-max <sub>B</sub> – Y <sub>B</sub>	± 0.07	+ 0.10	+ 0.12	NA

NA = Not applicable

### **KODAK CONTROL STRIPS, PROCESS C-41**

Use KODAK Control Strips, Process C-41, to monitor Processes C-41, C-41B, and C-41RA. By plotting the densities of the different steps of the strip, you can monitor the D-min, speed (LD), and contrast (HD – LD) of your process, and detect retained silver (by calculating and plotting D-max<sub>B</sub> – Y<sub>B</sub>).

### **KODAK Control Strips, Process C-41 (35 mm) (CAT No. 180 3709)**

These 35 mm strips are supplied in 100-foot rolls of approximately 120 strips with cutoff notches at 9½-inch (24.1 cm) intervals. A reference strip is included with each roll. The roll is wound *emulsion side in*, with the D-min ends of the strips toward the outer end of the roll.

Each strip has 12 density steps: a yellow step or yellow patch; 10 equal-increment density steps; and a D-min area. The 10 equal-increment density steps include a D-max step at the top, as well as the HD and LD steps, which are marked by a “U” or notch. The D-min area is the area adjacent to the black dot near the bottom of the strip.

### **KODAK Control Strips, Process C-41 (CAT No. 151 9677)**

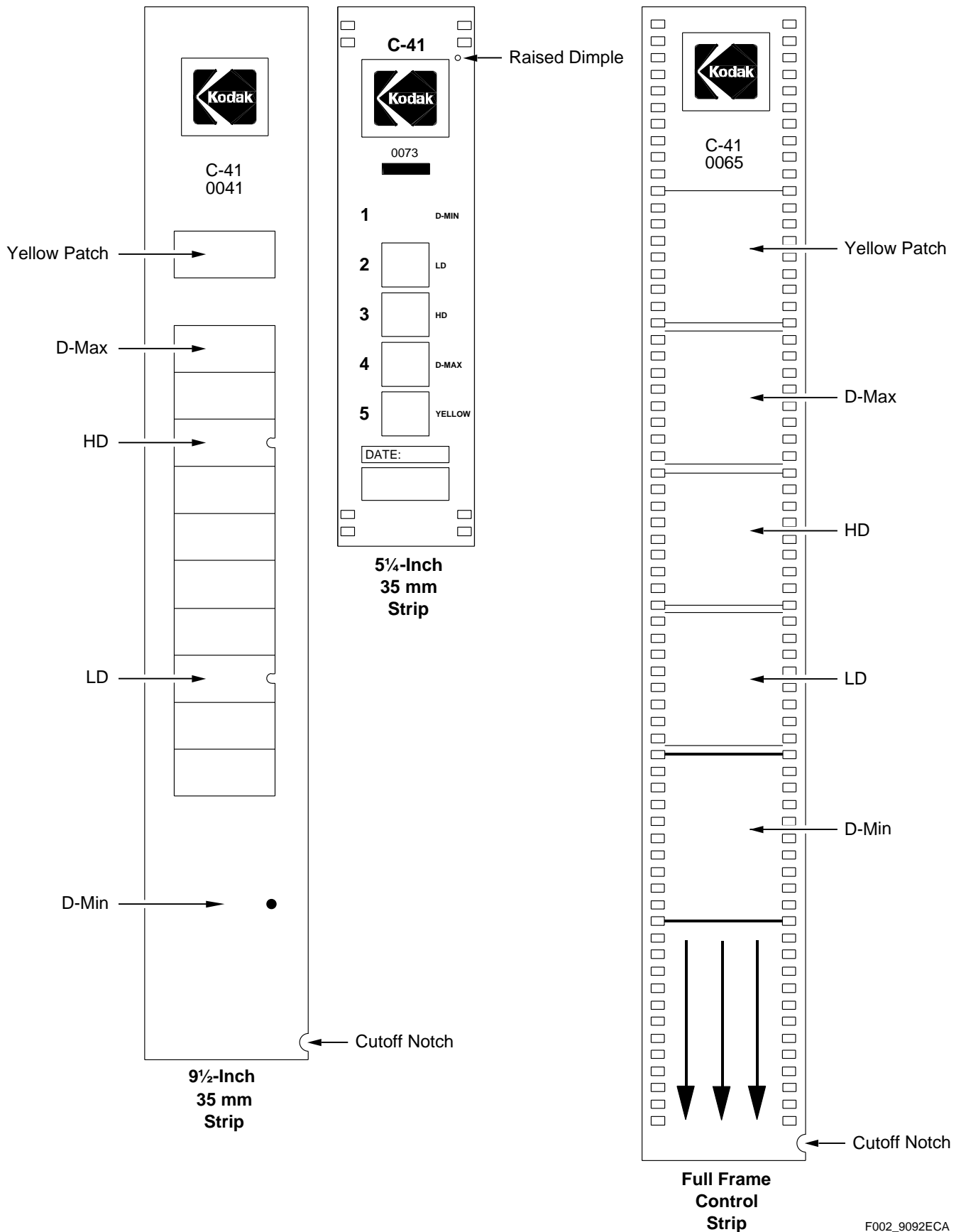
These 35 mm x 5¼-inch strips are supplied in a box of five foil packages that contain 10 strips each. Each box includes a reference strip. The ends of the strips are perforated for use with standard control-strip racks. Each strip has five steps: D-min, LD, HD, D-max, and yellow. A raised dimple is located on the emulsion side at the low-density end of the strip.

### **KODAK Full Frame Control Strips, Process C-41 (35 mm) (CAT No. 157 6701)**

These 35 mm strips are supplied in 100-foot rolls of approximately 80 strips with cutoff notches at 15-inch (38.1 cm) intervals. The roll is wound *emulsion side in*, with the D-min ends of the strips toward the outer end of the roll. A reference strip is included with each roll.

Each strip has five full-frame density steps: D-min, LD, HD, D-max, and yellow. These strips are designed primarily for use with minilab system printers that use a film scanner as a built-in densitometer. However, you can use them with any densitometer that can read large-area transmission density.

Figure 5-1 KODAK Control Strips, Process C-41



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F002\_9092EC

## Storing and Handling Control Strips

Store unused control strips at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) or lower. Handle unprocessed strips in total darkness. Remove only a day's supply from one package at a time; reseal and return the package to the freezer as quickly as possible. Do not keep the package out of the freezer for more than 1 hour per day. Store your daily supply of control strips in a lighttight container at room temperature. At the end of the day, discard any unprocessed strips that you removed from the freezer.

Handle control strips by the edges to prevent fingerprints and surface damage. If film sticking, static marking, or moisture mottle occurs, allow the strips to warm up to room temperature before you process them.

When your shipment of control strips arrives, remove the reference strip from the box before you put the control-strip boxes in the freezer. Store the reference strip in its envelope when you are not using it.

## Starting Out

To begin process monitoring, you will need—

- KODAK Control Strips, Process C-41
- An electronic densitometer equipped with Status M filters
- KODAK Process Record Form Y-55 or similar graph paper
- Red, green, and blue pencils

You can also plot your process by using the procedure in the KODATEL Quality Management System.

## Processing Control Strips

Each time you process a control strip, position it in the same location in your processor. In continuous processors, process the D-min end of the strip first; in rack-and-tank processors, fasten the strip to a film clip with the D-min end up.

Process a control strip —

- At the beginning of the day or shift before processing customer work
- At regular intervals with customer work
- At the end of the day or shift

## Plotting Control-Strip Densities

Create a control chart by using the KODAK Process Record Form Y-55 or similar graph paper. Follow the procedure given below. Your chart will look like the examples shown in this section.

1. Draw in the action and control limits given in Table 5-1. Use black for the action limits and red for the control limits.
2. Remove the reference strip from the box of control strips. If you removed the box from cold storage, allow the reference strip to warm up to room temperature before you remove it from its envelope (about 15 minutes). Exposing a frozen strip to warm, moist air can cause low readings, particularly in the higher-density patches.
3. Measure the Status M densities in the center of each patch with a precision electronic densitometer. **Do not**

move the strip as you make the density reading or you may affect the precision and repeatability of the measurements. Measure the blue density of the D-max ( $D\text{-max}_B$ ) and yellow ( $Y_B$ ) steps, and measure the red, green, and blue densities of the LD, HD, and D-min steps. If you have several boxes of strips with the same code number, average the readings of all the reference strips. A code number on the box label and the reference and control strips identifies each batch.

4. To calculate aim values, add the correction factors supplied in the instruction sheet packaged with each box of control strips to the reference-strip densities. Note the sign of the correction factor. If it is negative, you need to subtract the correction factor. If you averaged the reference-strip readings from several boxes of the same code number, apply the correction factors to the average. These corrected density values are the aim values for that batch of control strips. Record them in the proper spaces in the left margin of Form Y-55.
  - To obtain the HD – LD aim values, subtract the adjusted LD densities from the adjusted HD densities.
  - To obtain the  $D\text{-max}_B - Y_B$  aim value, subtract the adjusted blue-filter density of the yellow step from the adjusted blue-filter density of the D-max step.
5. Process a control strip and measure the same patches that you measured in step 3.
6. Calculate the variations from aim by subtracting the aim densities from your control-strip densities. Plot the variations on your control chart.
  - Plot differences that are **larger** than the corresponding aim values (+ values) **above** the aim line.
  - Plot differences that are **smaller** than the aim values (– values) **below** the aim line.
7. If any of the variations from aim plot beyond the action or control limits, process another control strip. If the second strip confirms the results, determine the cause of the problem. The diagnostic charts and control-chart examples in this section will help you troubleshoot your process problems.
8. Whenever you take corrective action, process another control strip to confirm that the change you made returned the process to control before you resume normal processing. See *Control-Chart Examples*.

## Changing to a New Batch of Control Strips

When you change from your current batch of control strips to strips with a different code number, make a crossover to confirm that both code numbers provide the same information. The following procedure allows you to make adjustments for minor code-to-code variations. Using the crossover procedure in the KODATEL Quality Management System will simplify the process.

*Be sure that your process is stable and in control before you begin using a new batch of control strips.*

1. While you still have a week's supply of control strips of your current code, process one control strip from the new batch of strips with one strip from the current batch *in three separate runs*.
2. Read and record the densities of the processed strips.
3. Determine aim values for the new batch of control strips by following steps 2 through 4 under *Plotting Control-Strip Densities*.
4. For your current batch of strips, calculate the variations from aim by subtracting your current aim densities from the densities of the three strips. Plot the variations on your control chart.
5. For the new batch of strips, calculate the variations from aim by subtracting the new aim densities calculated in step 3 from the densities of the three strips. Plot the variations on your control chart.
6. Calculate the differences between the variations from aim of the current strips and the new strips. Average these differences, and then divide the result by 2.
7. Depending on the sign of the differences, adjust the aim values for the new batch of strips by adding or subtracting the results from step 6. The amount of the adjustment should not exceed the aim-value adjustment tolerances given in Table 5-1. If the adjustment is greater than the tolerance, determine the cause. Check your calculations, densitometer, and control strips.
8. Record the new aim values and the code number of the new batch of strips on your control chart, and begin using the new strips.

## Mathematical Crossover Procedure

After you have mastered the crossover method described in the previous section, you may want to use a mathematical method. It requires no plotting or subtracting of negative numbers, and no side calculations of deviations or averages. You can use longhand arithmetic or a calculator. Follow the list of calculations shown in Table 5-2. An example is given to help you. You may also want to make copies of the table and use them as worksheets.

**Table 5-2**

Calculation	Example Red LD	Red	Green	Blue
Current reference value	0.52			
+ New initial reference value	+0.55	+	+	+
Equals	1.07			
x 3	x 3	x 3	x 3	x 3
Equals	3.21			
+ New strips	+ 0.54	+	+	+
	+ 0.55	+	+	+
	+ 0.56	+	+	+
– Current strips	- 0.55	–	–	–
	- 0.52	–	–	–
	- 0.56	–	–	–
Equals	3.23			
÷ 6	÷ 6	÷ 6	÷ 6	÷ 6
Equals	0.538			
New adjusted* reference value (rounded up)	0.54			

\* The difference between the new adjusted reference value and the new initial reference value should not exceed the aim-value adjustment tolerance.

## INTERPRETING YOUR CONTROL PLOT

Your control plot provides a running record of your process. It will show how consistent your process is, and how well it meets your aim. It provides you with helpful information for analyzing and correcting process problems. Your process will produce acceptable results if your control strips always plot within the control limits.

### Corrective Action

When a control strip plots outside the control limits, or if the plot shows a gradual drift toward an out-of-control condition, immediately check for the cause and correct it. First, determine if the process drifted out of control slowly over time or if it occurred suddenly.

#### Gradual Change

Gradual changes to an out-of-control condition indicate a problem that could be caused by the following:

**Improper replenishment**—Check that the replenishment rate is correct and that the replenishment system is operating properly. Also check for an incorrectly mixed replenisher.

**Evaporation or oxidation**—Check for low utilization or air drawn into the processing solutions by a bad pump, a recirculation-system leak, or a poorly placed ventilation fan.

**Contamination**—Check for photographically active materials that leach slowly into the solutions. The contaminant may come from any material that is in contact with the solutions, such as the filters, plumbing, etc.

**Incorrect mixing**—Check for mixing errors caused by improper measurement, improper calibration of mixing tanks, etc. If you suspect that the problem was caused by replenisher solution that was mixed incorrectly, mix a new batch of replenisher to see if a fresh mix gradually corrects the problem.

#### Sudden Change

Sudden changes to an out-of-control condition indicate a problem that can be caused by the following:

**Control strip**—Check that you used a control strip from the correct code number. Remember, if you change code numbers, you need to establish new aim values for the new batch (see *Changing to a New Batch of Control Strips*). Check that the control-strip code numbers match those of the reference strip, and that the strips were handled and stored properly.

**Densitometer**—If your densitometer is not working properly or is out of calibration, the density readings will be wrong. This can falsely signal a process change. Check that you used Status M filters.

**Time or temperature**—Check that the time and temperature were set correctly, particularly if they are easy to change.

**Agitation**—Check that pumps are working and that the burst distribution, duration, and interval are correct.

**Contamination**—Very small amounts of bleach or fixer can contaminate the developer tank or replenisher solution and cause a large density and color shift.

**Solution mixing**—If the sudden change occurs after you have mixed a fresh tank solution, check that it was mixed correctly.

**Aim Values**—Check that you compared the control-strip densities with the correct aim values.

**Note:** When you troubleshoot a problem, check the easiest and most obvious causes first; then check the more difficult and less likely causes.

To help determine the cause of an out-of-control condition, use the information under *Diagnostic Charts* and the sample plots under *Control-Chart Examples*. The diagnostic charts are flowcharts that list problems and lead you through possible causes and solutions. The control-chart examples demonstrate the effects of a single condition on control-strip plots. If your chart shows a similar effect, you may be able to tell if your process is affected by the same problem. However, sometimes a diagnosis is more difficult, because a problem may have more than one cause.

## Daily Processing Log

Use a daily processing log for your processor. A processing log will provide you with a convenient means of keeping track of the amount of film you process and can provide you with valuable information in case of process and/or machine problems.

## How Each Processing Solution Affects Your Results

Each solution affects the emulsion differently. Understanding the reaction of each solution can help you diagnose processing problems. See the process specifications listed in Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*; Section 3, *Sink-Line, Batch, and Rotary-Tube Processors*; and Section 4, *Minilab Processors*.

### Developer

The developer chemically reduces the exposed silver halide in the film to form a metallic silver image. At the same time, the color developing agent in the developer oxidizes and combines with color couplers at the site of the silver image in each of the dye-forming emulsion layers to form a color-dye image. Once the dye image has formed, there is no need for the silver image. It is removed later by bleaching and fixing.

The amount of cyan, magenta, and yellow dye formed depends on exposure and developer activity. Temperature, time, replenishment rate, replenisher concentration, agitation, and the rate at which solutions diffuse into the emulsion affect developer activity. Time, temperature, and agitation affect the diffusion rate. With *too much* developer activity, too much dye forms and the density values will plot higher than normal. With *too little* activity, not enough dye forms and the density values will plot lower than normal.

### Bleach

The bleach stops the developer activity and converts metallic silver back to silver halide. The silver halide is later dissolved in the fixer.

Bleach concentration and the rate at which the solution diffuses into the emulsion affect bleach activity. Time, agitation, and temperature affect the rate of diffusion. Replenishment rate, mixing procedures, and aeration efficiency affect the chemical concentrations. Bleach aeration adds oxygen needed to convert the reduced bleaching agent to an active form.

If bleaching is inadequate, less than the normal amount of cyan dye is formed because some of the dye remains in the leuco (colorless) condition. This adversely affects the color balance. Bleach time that is too short, bleach that is too dilute, or insufficient bleach aeration can cause leuco-cyan dye to form.

Inadequate bleaching can also cause retained silver because not all the metallic silver is converted to silver halide. Leuco-cyan dye and retained silver adversely affect image quality, but you can correct both conditions by rebleaching and refixing the film in good solutions.

**Bleach Aeration**—In Process C-41, you must aerate the bleach to convert iron II back to iron III, the bleaching agent. If the concentration of iron II is not kept near zero, leuco-cyan dye is likely to form.

### Fixer

The fixer converts silver halide in the film into soluble silver complexes that are washed from the film. You can recover the silver with electrolytic silver-recovery units and/or chemical-recovery cartridges. Fixing efficiency depends on fixer activity and the diffusion rate into the emulsion. Temperature, replenisher concentration, and replenishment rate affect fixer activity. Time and agitation affect the diffusion rate.

Inadequate fixing may not remove all of the sensitizing dyes and silver halide. An increase in the red and green D-min densities of the control plot is one sign of incomplete fixing. Another sign is a milky appearance in the D-min areas of control strips and processed film. If this problem occurs, you can test the fixer by refixing the control strip (or film) in a fixer that you are sure is good. If refixing the strip corrects the control plot, the original fixer is probably exhausted. You can correct inadequately fixed film by refixing it.

The most probable causes of inadequate fixing are fixer that is diluted by excessive solution carryover, an inadequate fixing time, underreplenishment, a replenisher that is underconcentrated, and fixer sulfurization. Temperature has very little effect on the fixing rate if other fixer conditions are within tolerances. Agitation is necessary for uniform fixing.

### Wash

Washing removes residual chemicals from the film. If the chemicals are not removed, they can degrade the image and cause the dyes to fade. Good washing requires enough circulation to keep fresh water in contact with the emulsion. The water temperature must be warm enough to swell the gelatin so that the water moves freely into the emulsion to remove the chemicals, but not so warm that the gelatin melts or is permanently distorted.

For rack-and-tank processors, be sure that the entire rack is washed; if bleach or fixer is trapped on hanger clips, the solution can run down onto the film. Also, if the solution dries on the hangers, it can be carried back into the developer and can cause severe contamination. To avoid this problem, keep the level of the final wash high enough so that the entire rack is immersed during washing or you can spray-wash the rack just before it enters the dryer. If your processor uses a leader film, be sure to wash it thoroughly before you reuse it.

### Stabilizer/Final Rinse

The stabilizer or final rinse has no sensitometric effect on the film, but has the greatest impact on the physical quality of processed film. If the stabilizer or final rinse is underreplenished, or if it contains particulate material from a “dirty” water supply or biological growth, it can leave drying marks and deposits on processed film.

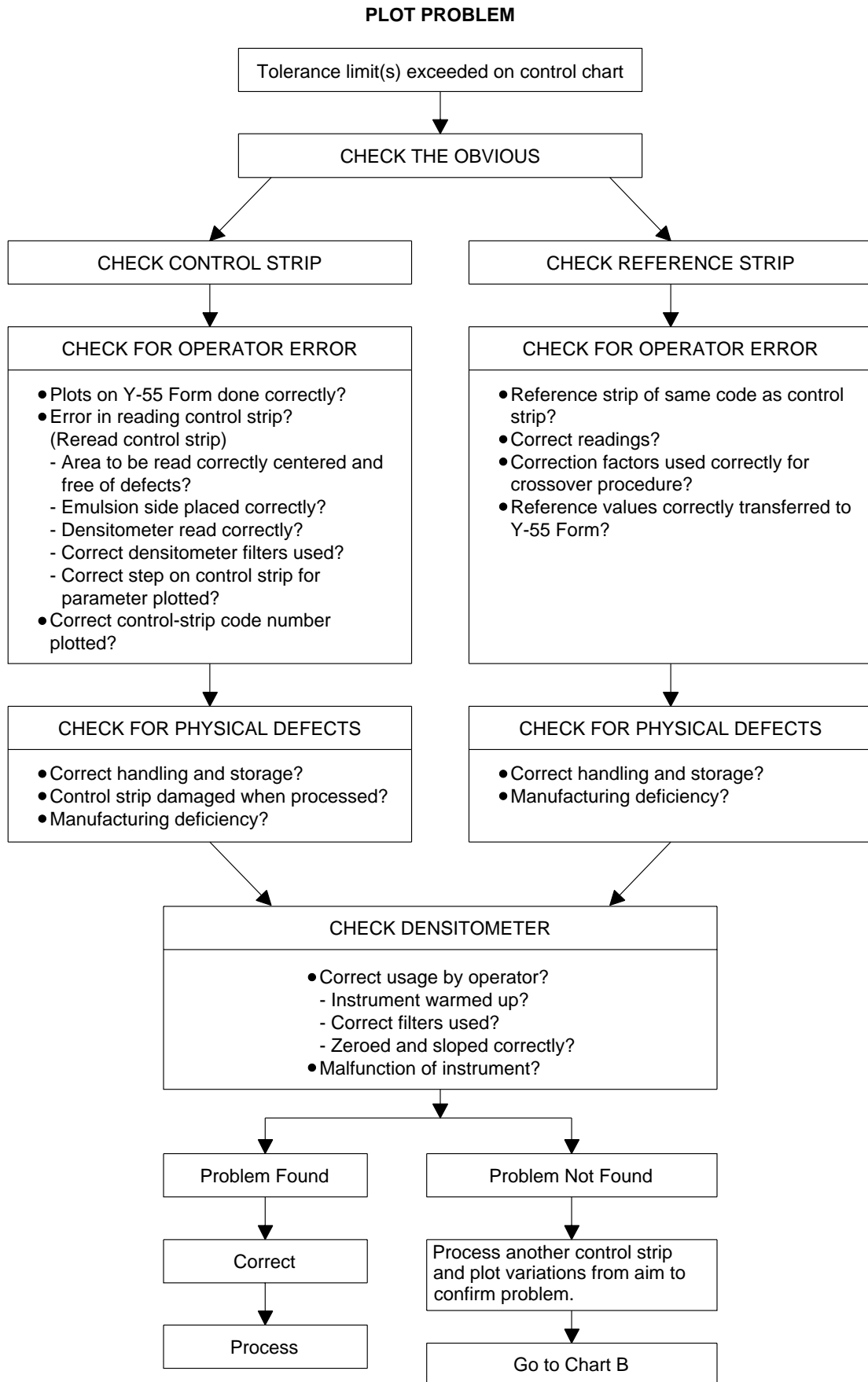
## DIAGNOSTIC CHARTS

The diagrams in this section provide you with a step-by-step approach to diagnosing processing problems. Summary charts show which detailed chart to consult for your problem. The charts give probable causes and suggest corrective procedures. Remedies for some processing problems are described in Section 1, *KODAK FLEXICOLOR Chemicals*.

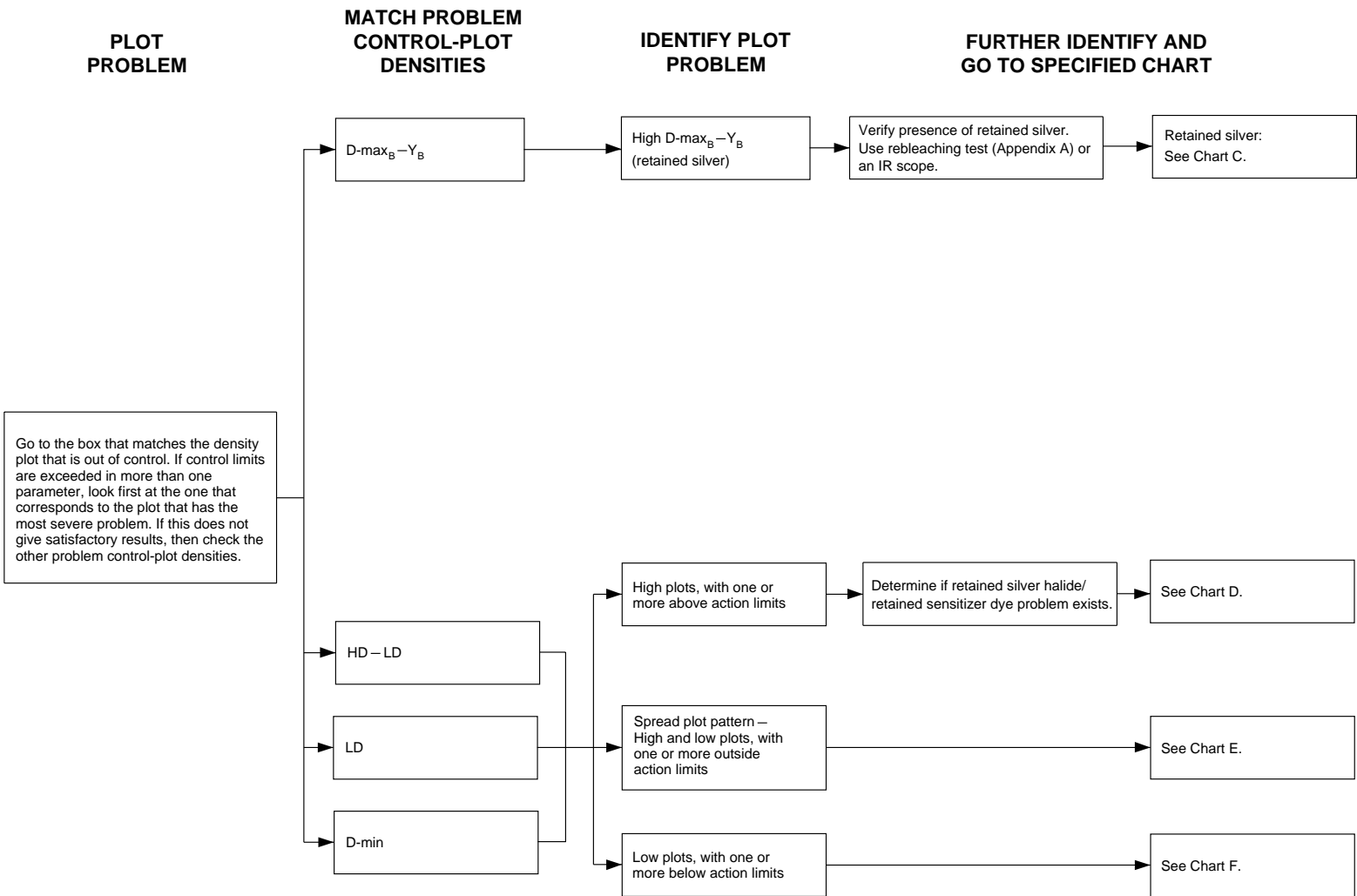
Chart	Example
A	Control-Chart Plots—Preliminary
B	Control-Chart Plots—Summary
C	Control-Chart Plots—Retained Silver
D	Control-Chart Plots—High Activity
E	Control-Chart Plots—Color Spread
F	Control-Chart Plots—Low Activity
G	Visual Appearance—Processing Solutions—Summary
H	Visual Appearance—Developer
I	Visual Appearance—Bleach
J	Visual Appearance—Fixer, Stabilizer, and Final Rinse
K	Visual Appearance—Film—Summary
L	Visual Appearance—Film—Scratches and Abrasions
M	Visual Appearance—Film—Surface Dirt and Adhesive Transfer
N	Visual Appearance—Film—Emulsion-Side Problems
O	Visual Appearance—Film—Drying Marks
P	Visual Appearance—Film—Scum
Q	Visual Appearance—Film—Pressure Marks, Fog, Static
R	Physical Appearance—Film—Sticking



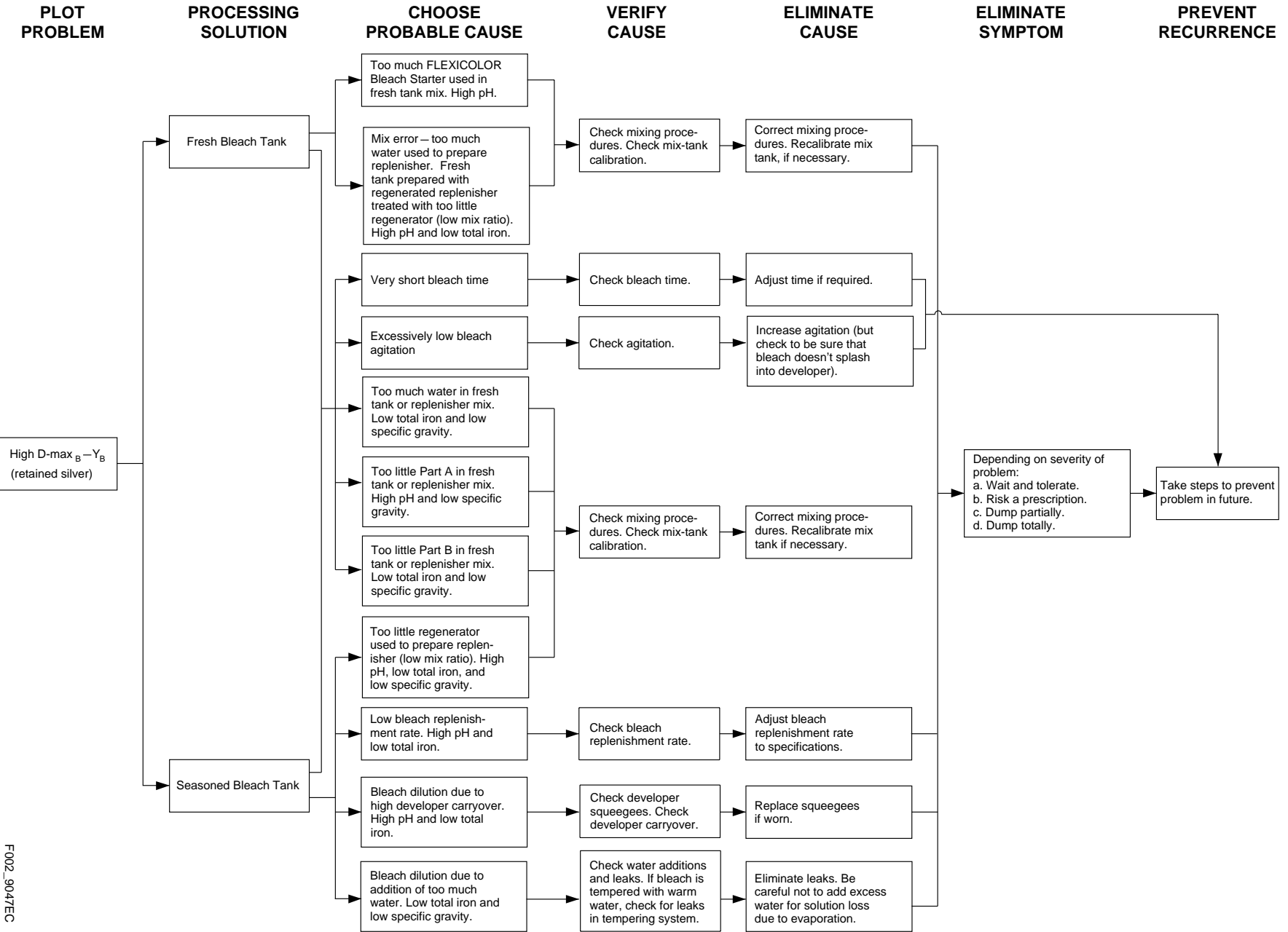
**Chart A**  
Control-Chart Plots—Preliminary



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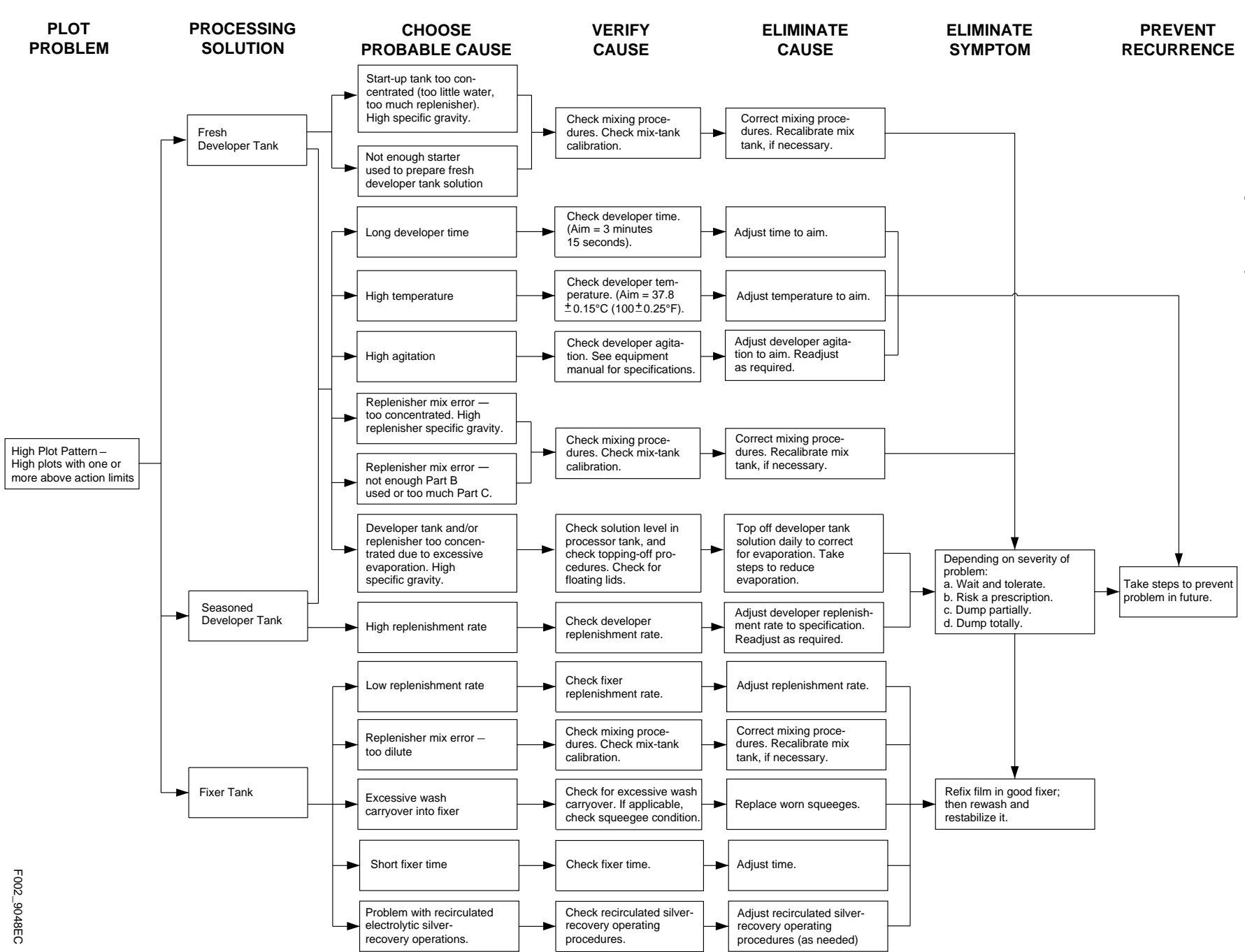


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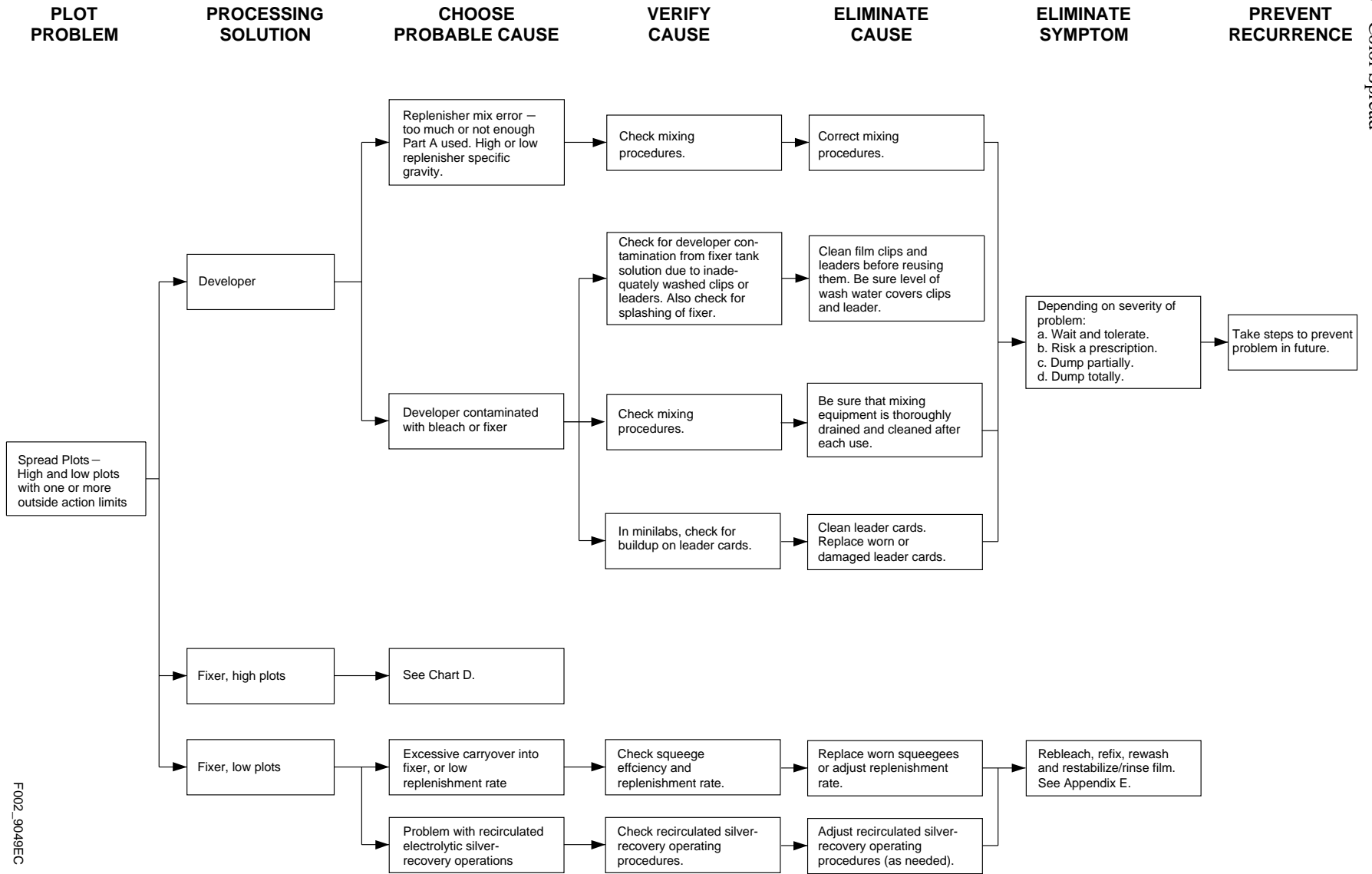
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**Chart C**  
Control-Charts Plots—Retained Silver

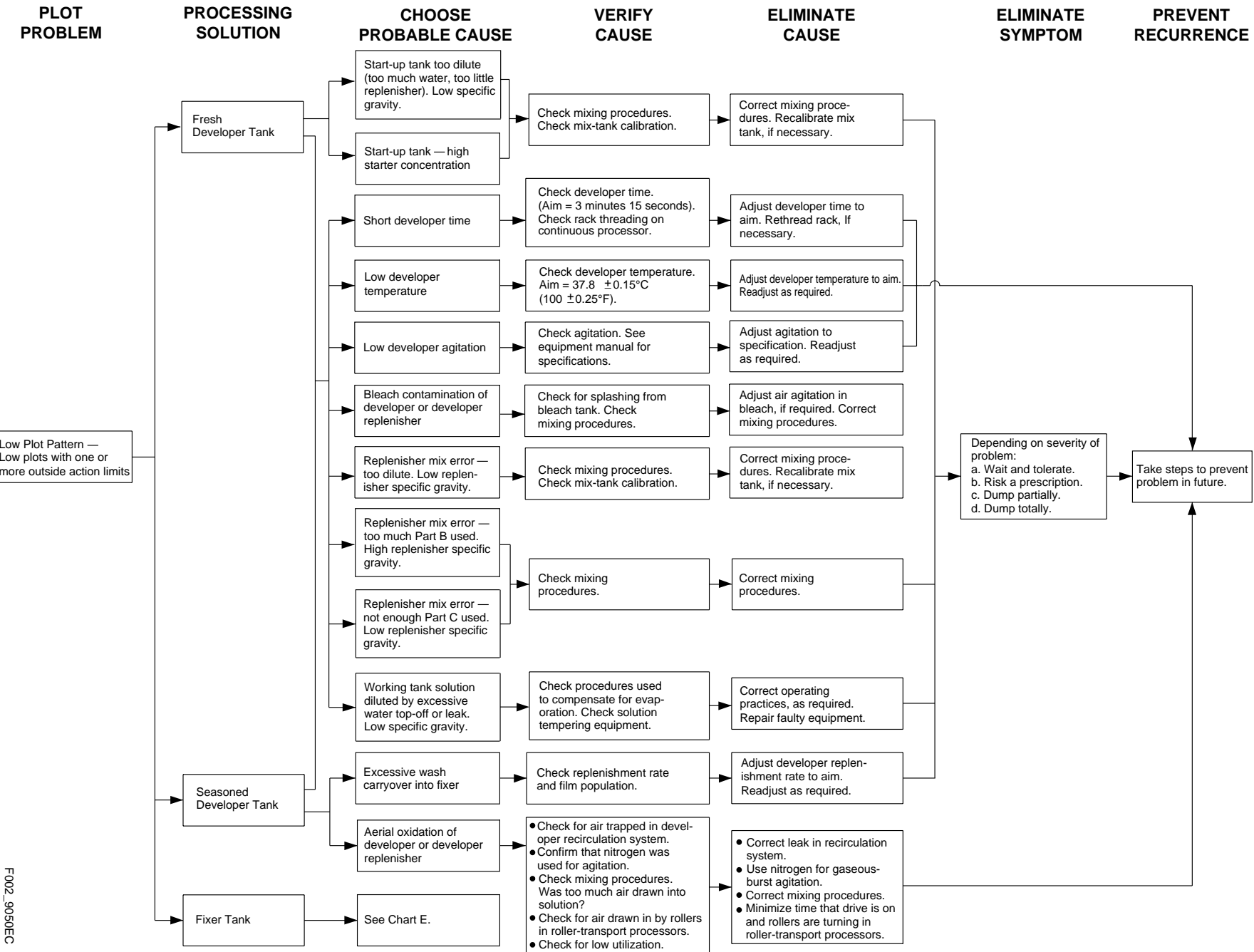


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Chart D  
Control-Chart's Plots—High Activity



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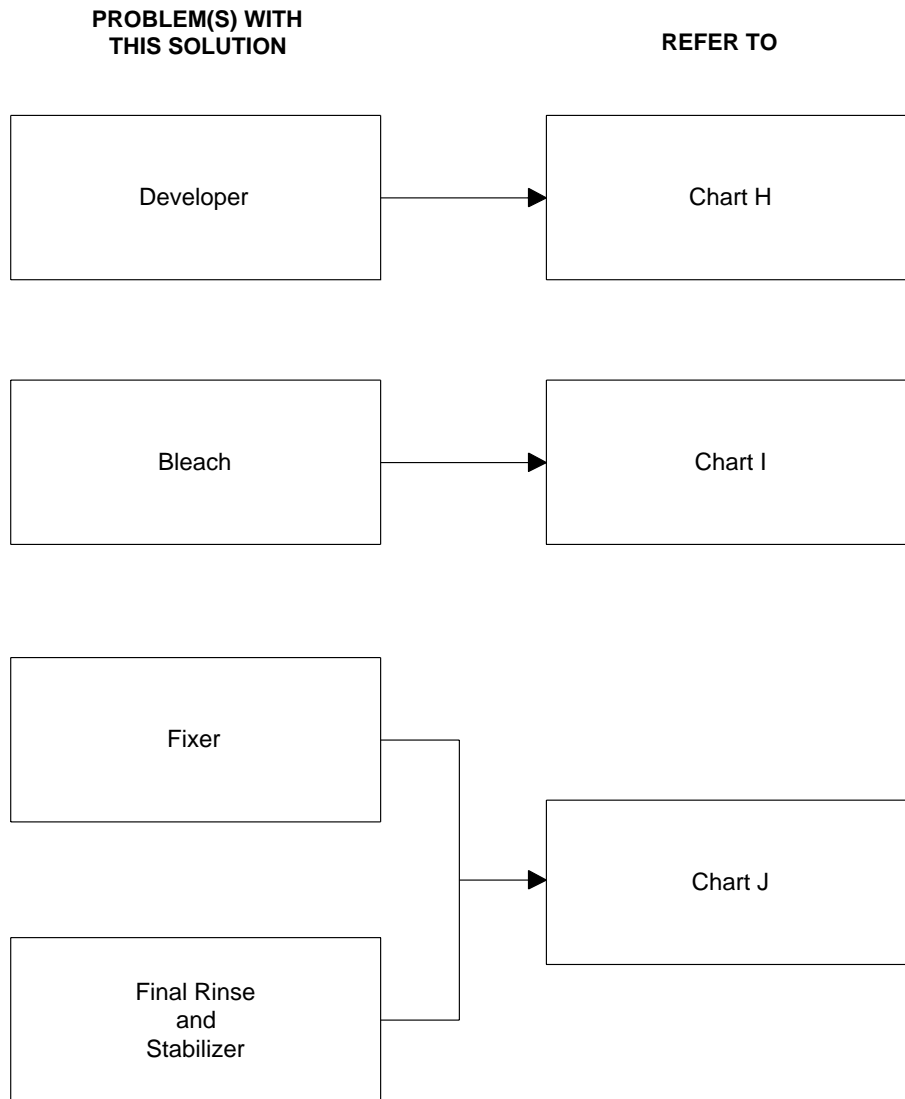


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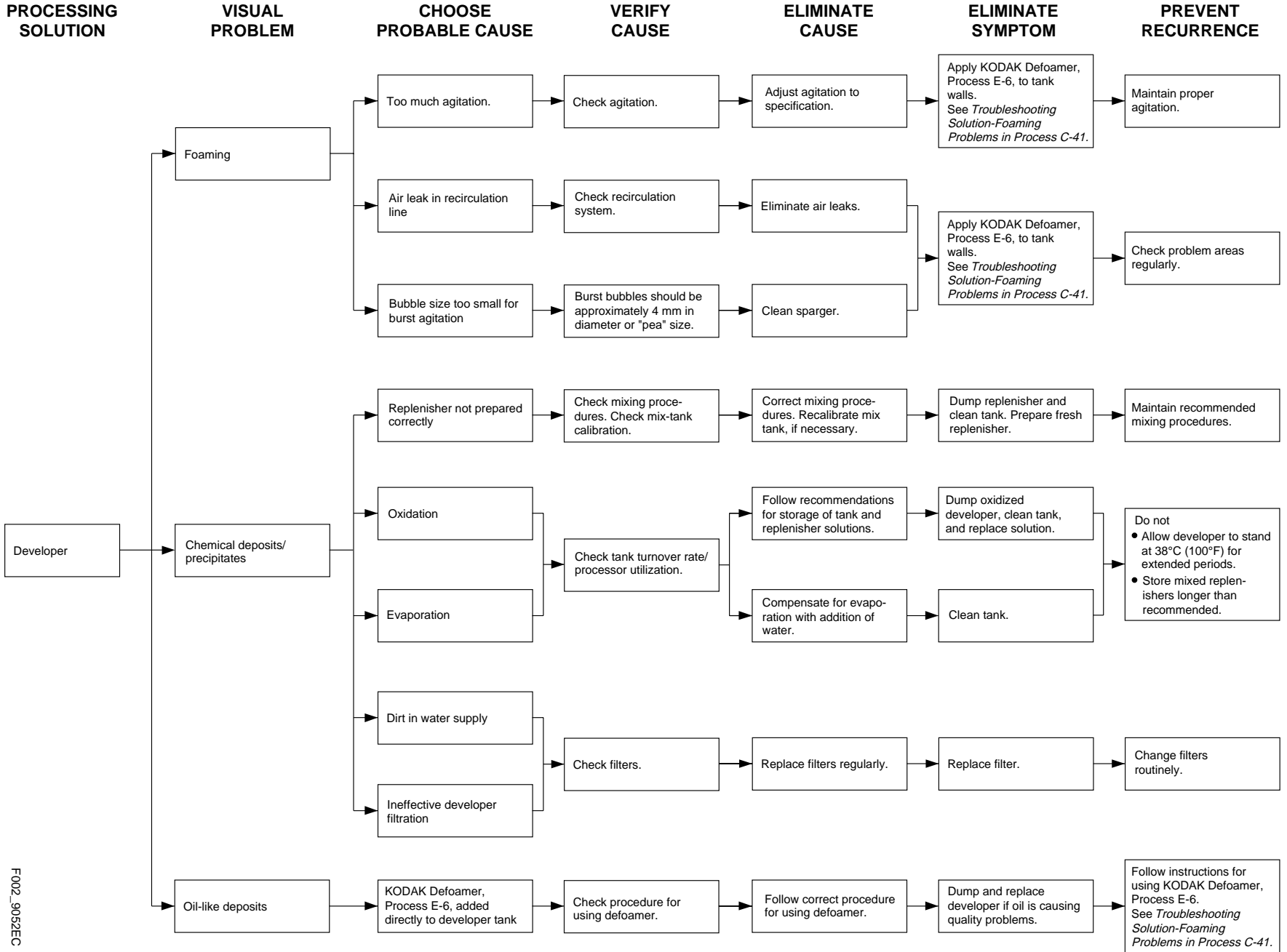
Chart F  
Control-Charts Plots—Low Activity

**Chart G**

Visual Appearance—Processing Solutions—Summary



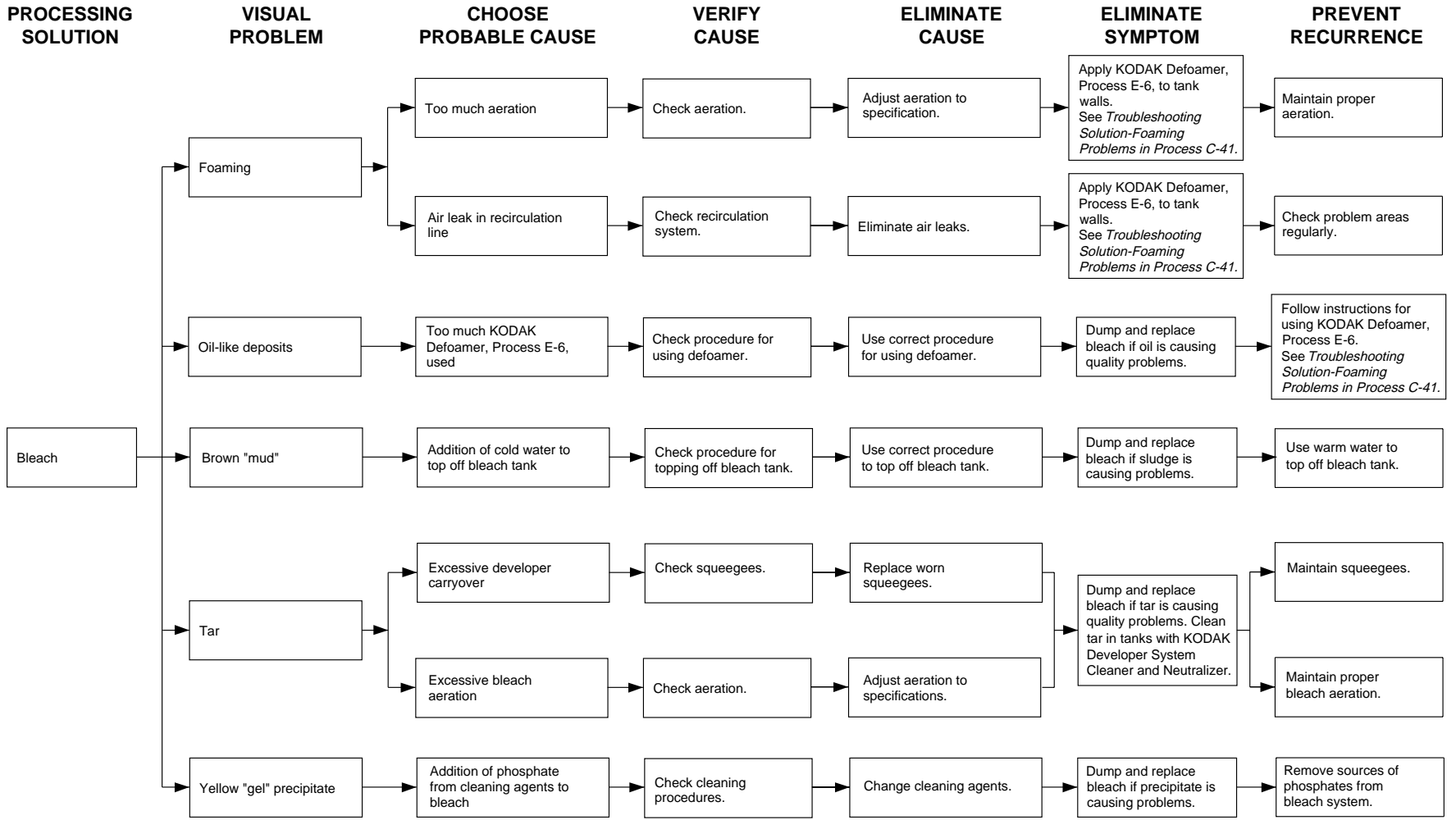
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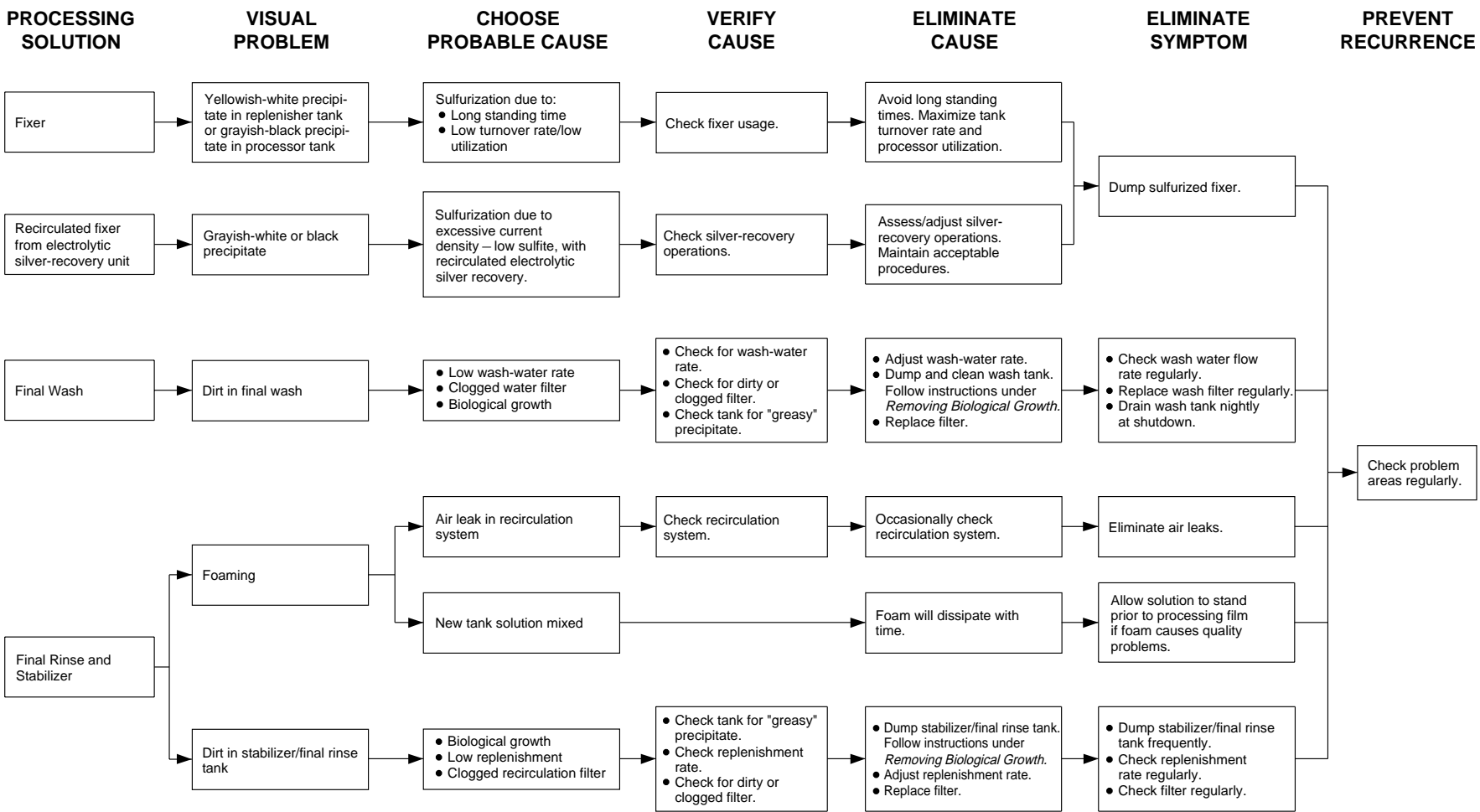
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Chart H  
Visual Appearance—Developer



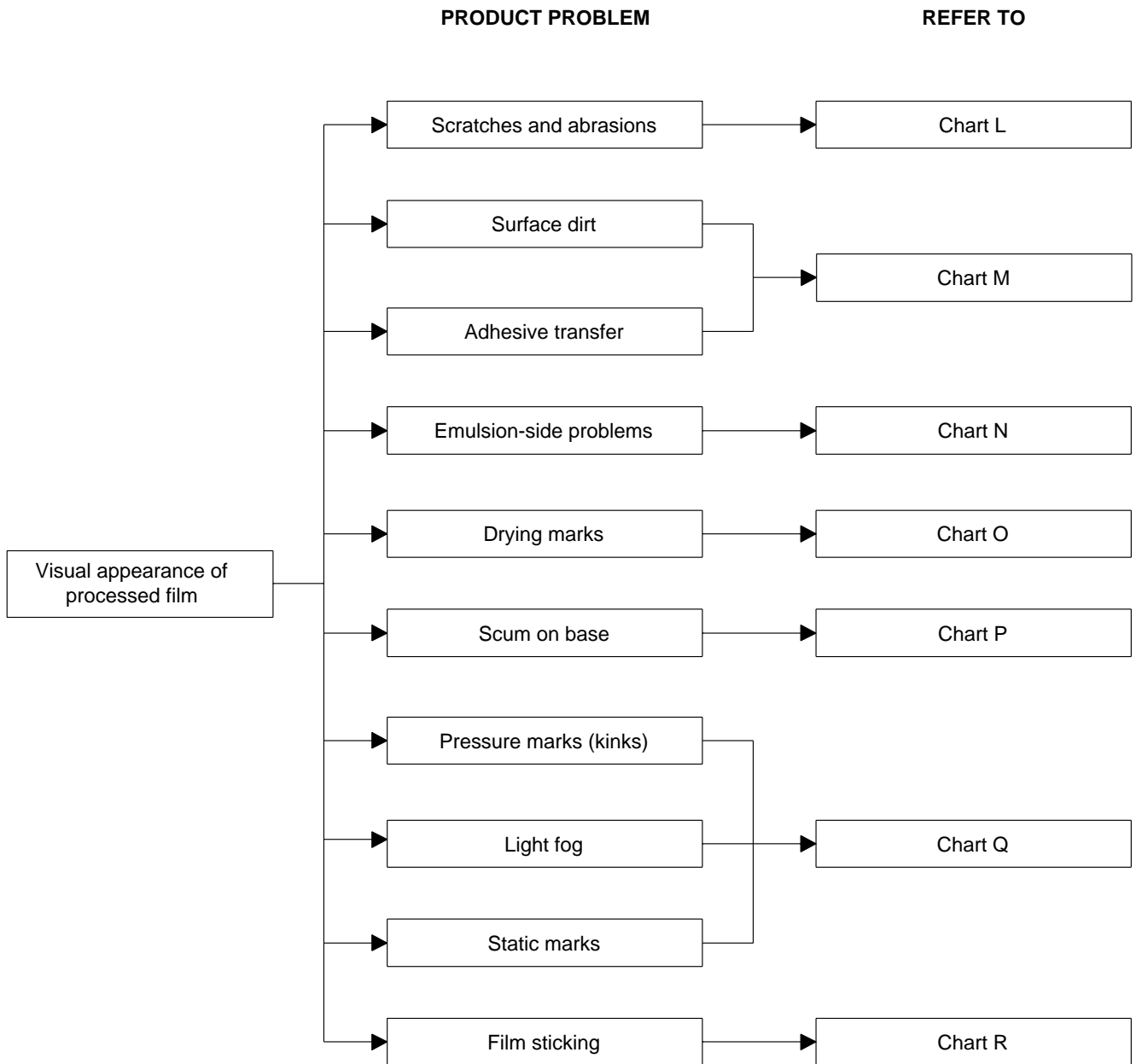


**Chart J**  
Visual Appearance—Fixer, Stabilizer, and Final Rinse

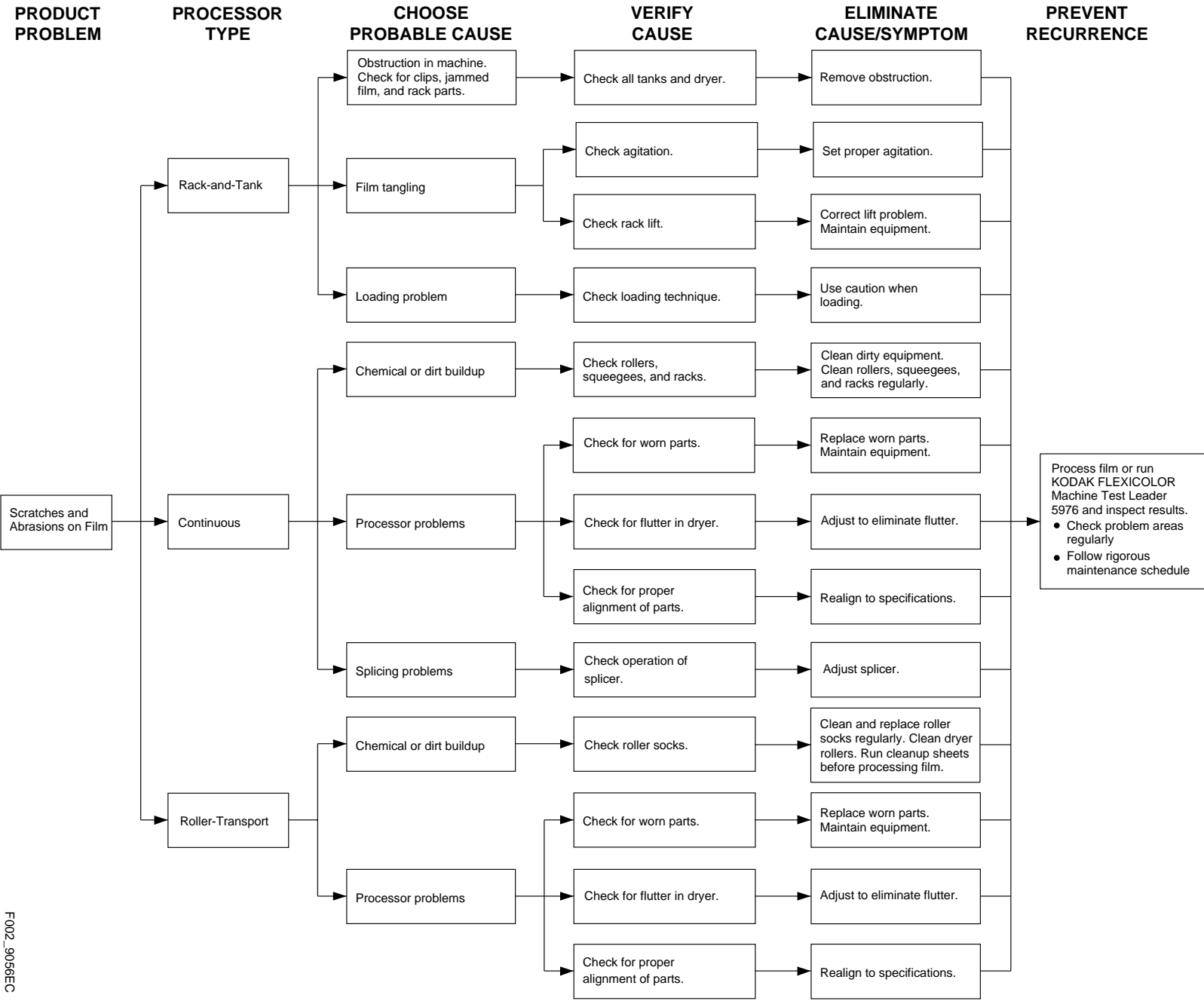


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**Chart K**  
Visual Appearance—Film—Summary



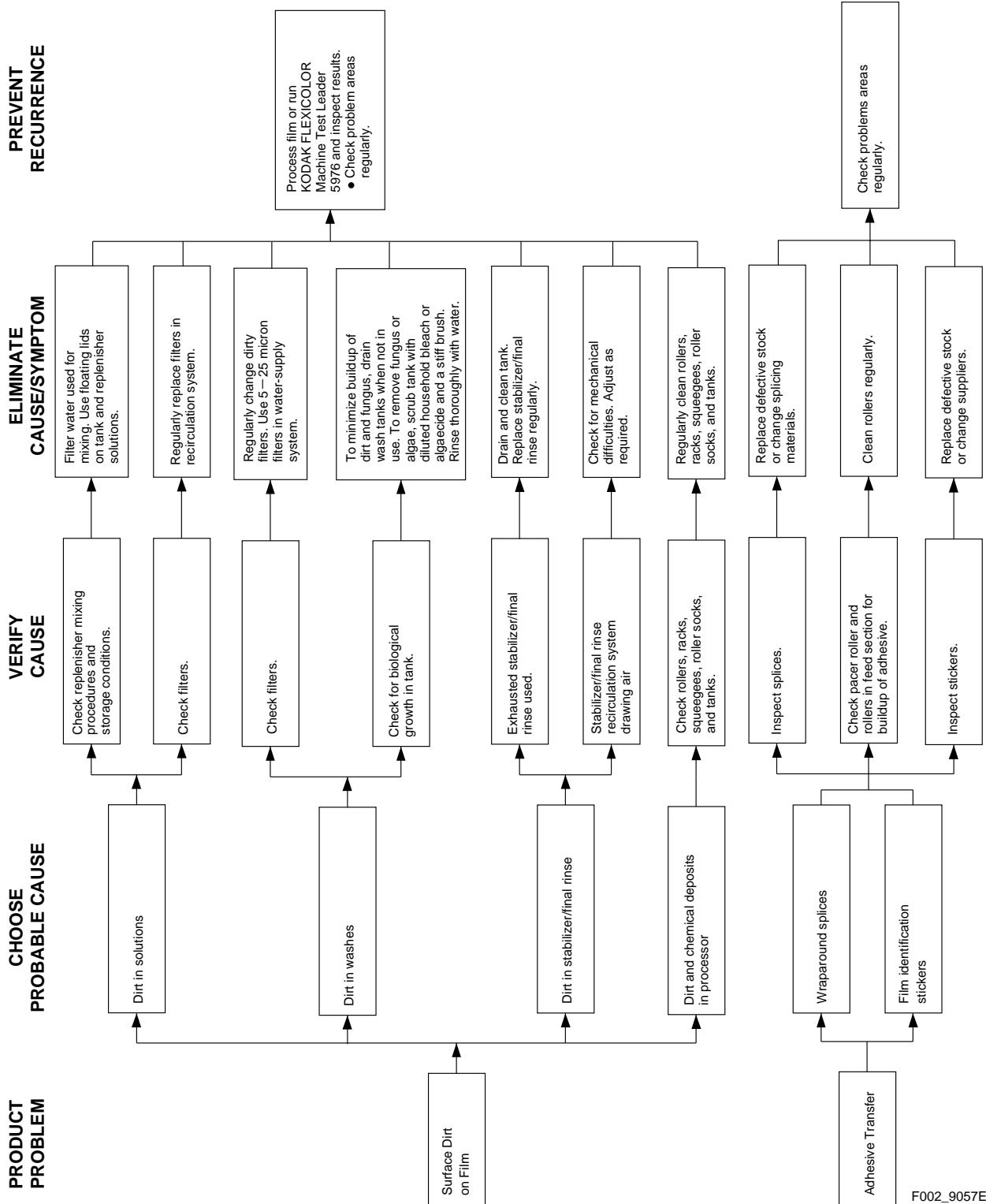
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**Chart L**  
Visual Appearance—Film—Scratches and Abrasions

**Chart M**  
 Visual Appearance—Film—Surface Dirt and Adhesive Transfer



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**Chart N**

Visual Appearance—Film—Emulsion-Side Problems

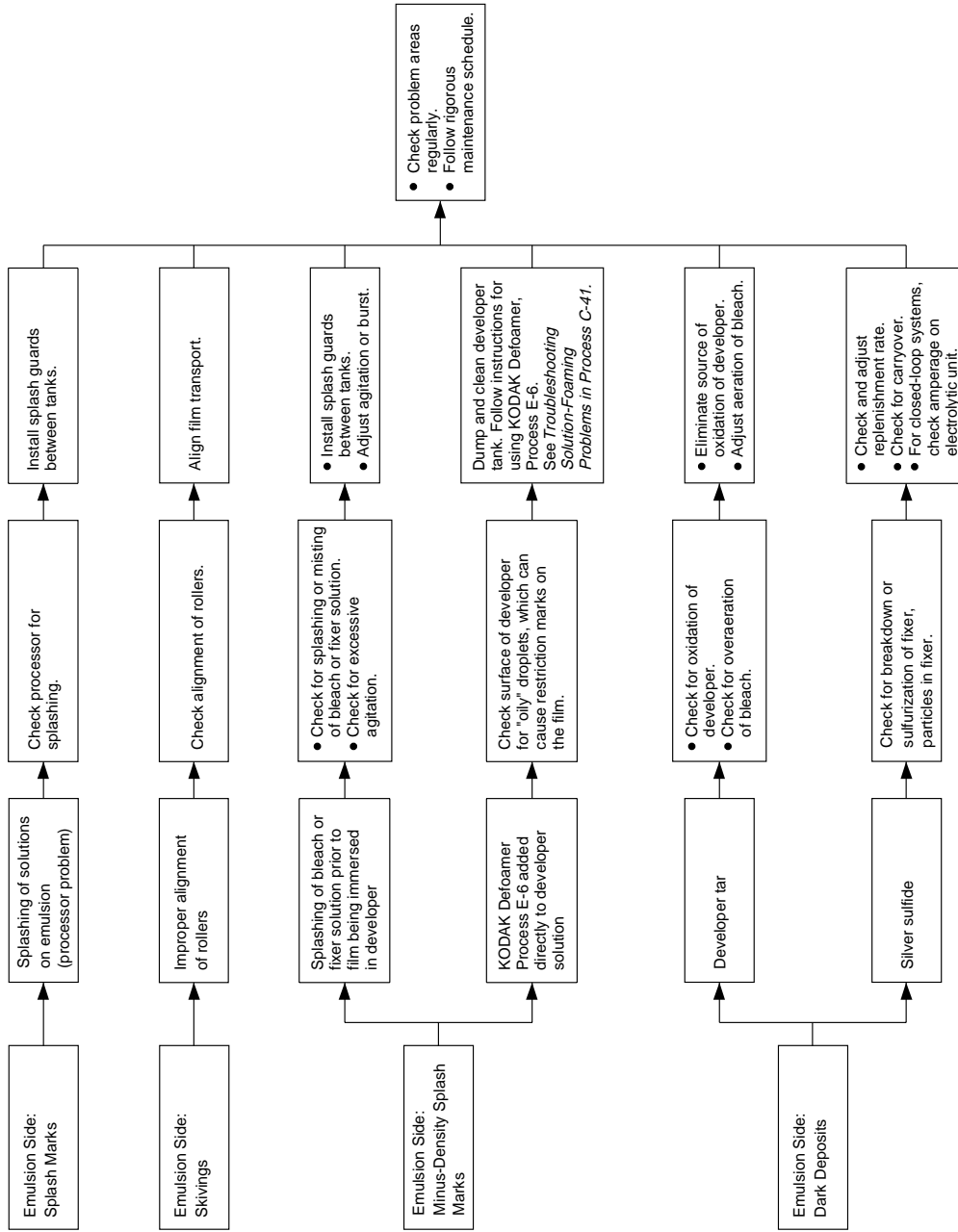
**PREVENT  
RECURRENCE**

**ELIMINATE  
CAUSE/SYMPTOM**

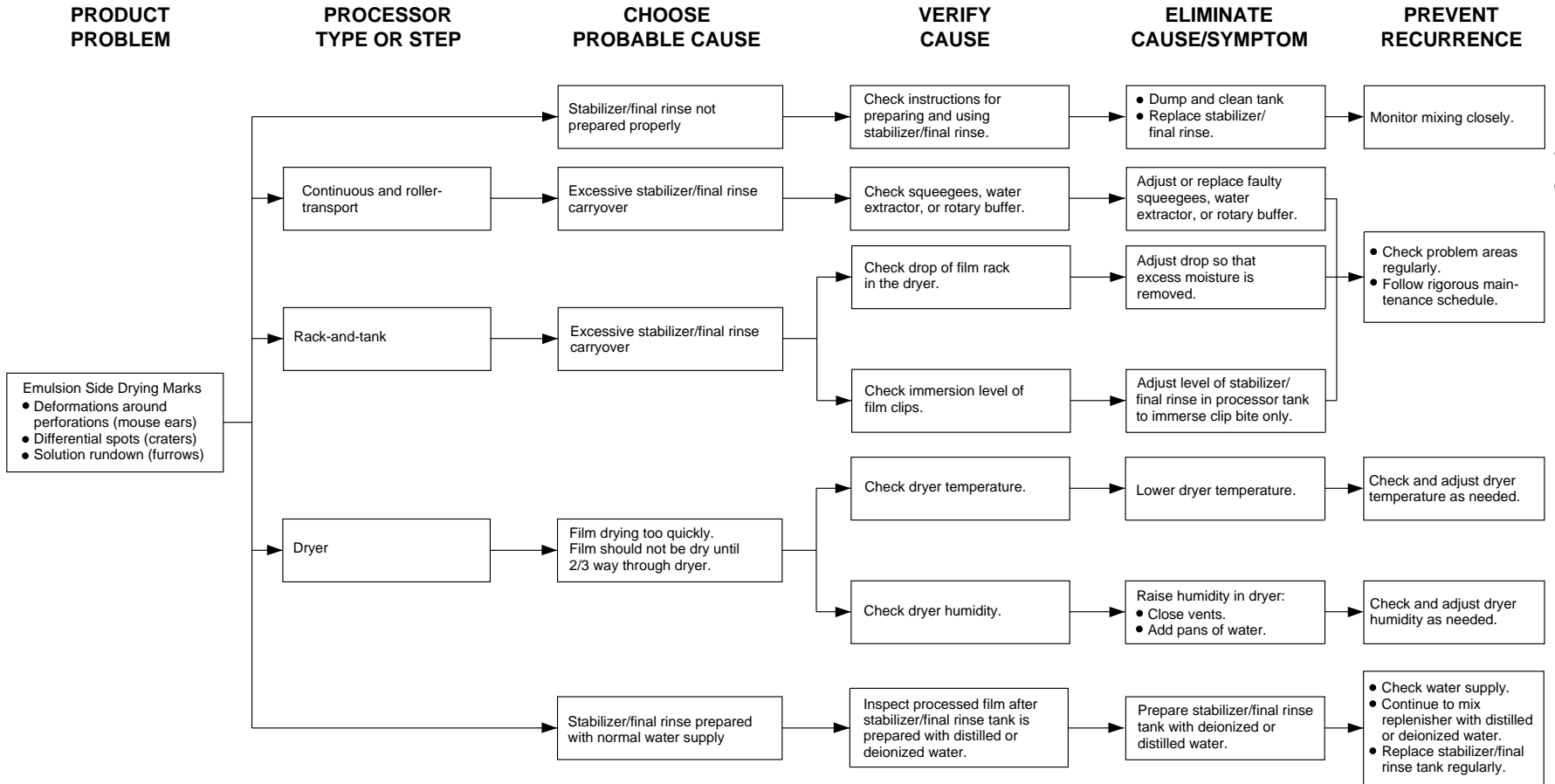
**VERIFY  
CAUSE**

**CHOOSE  
PROBABLE CAUSE**

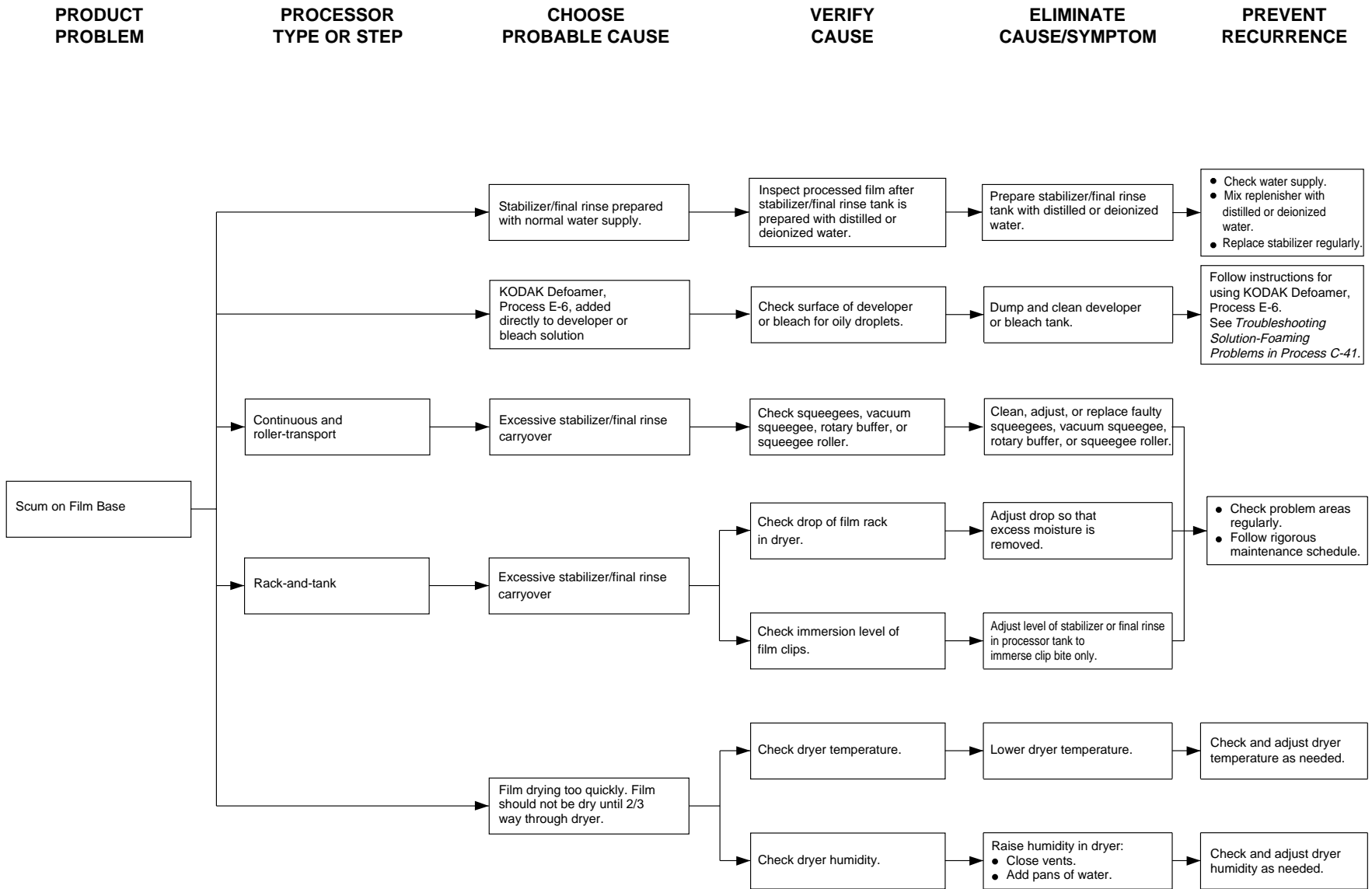
**PRODUCT  
PROBLEM**



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Note: Check probable causes on this chart in order of appearance.

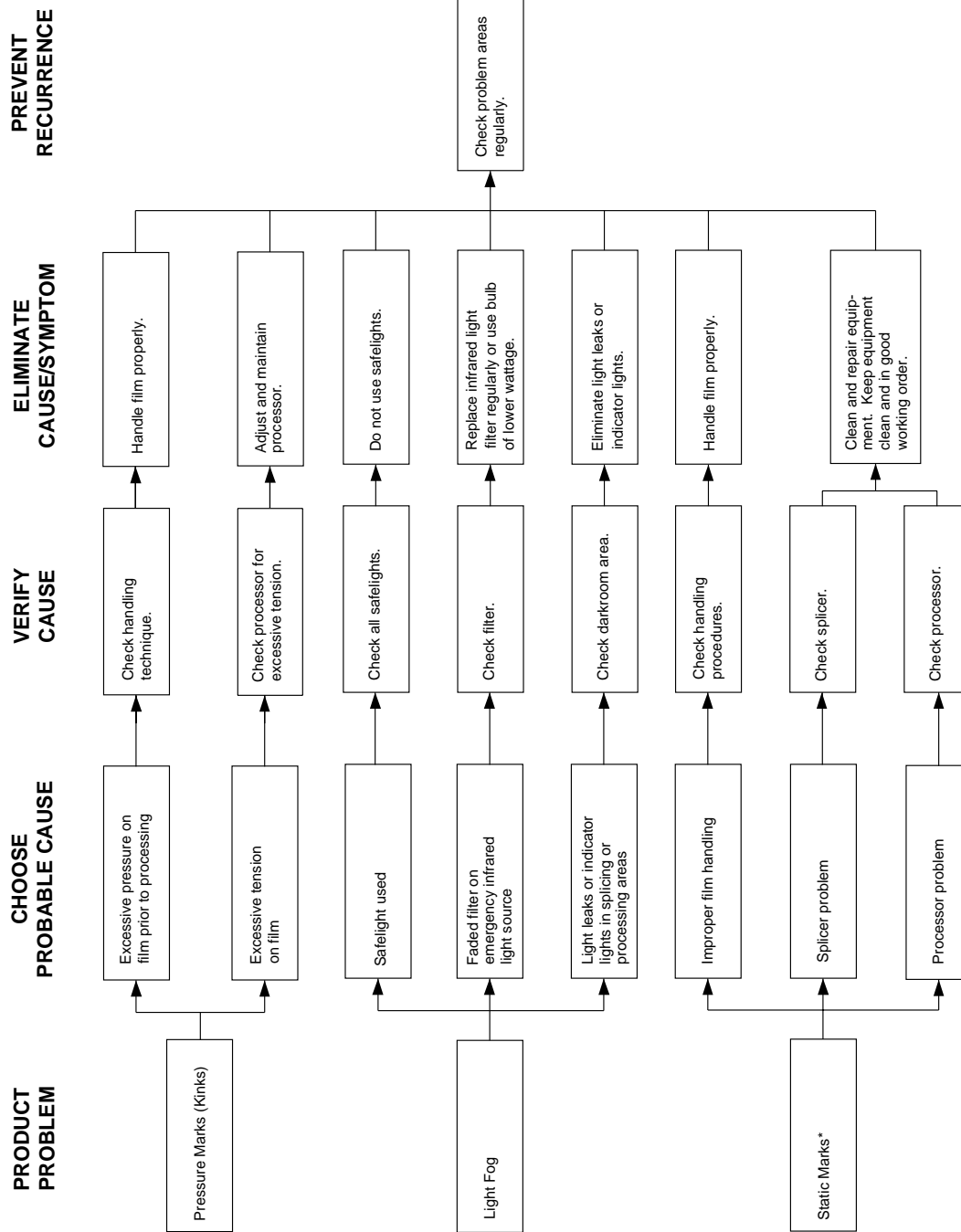


**Note:** To remove scum from the film, wash, repeat stabilizer/final rinse step, and dry, or clean the film. Do not use FLEXICOLOR Stabilizer III in minilabs.

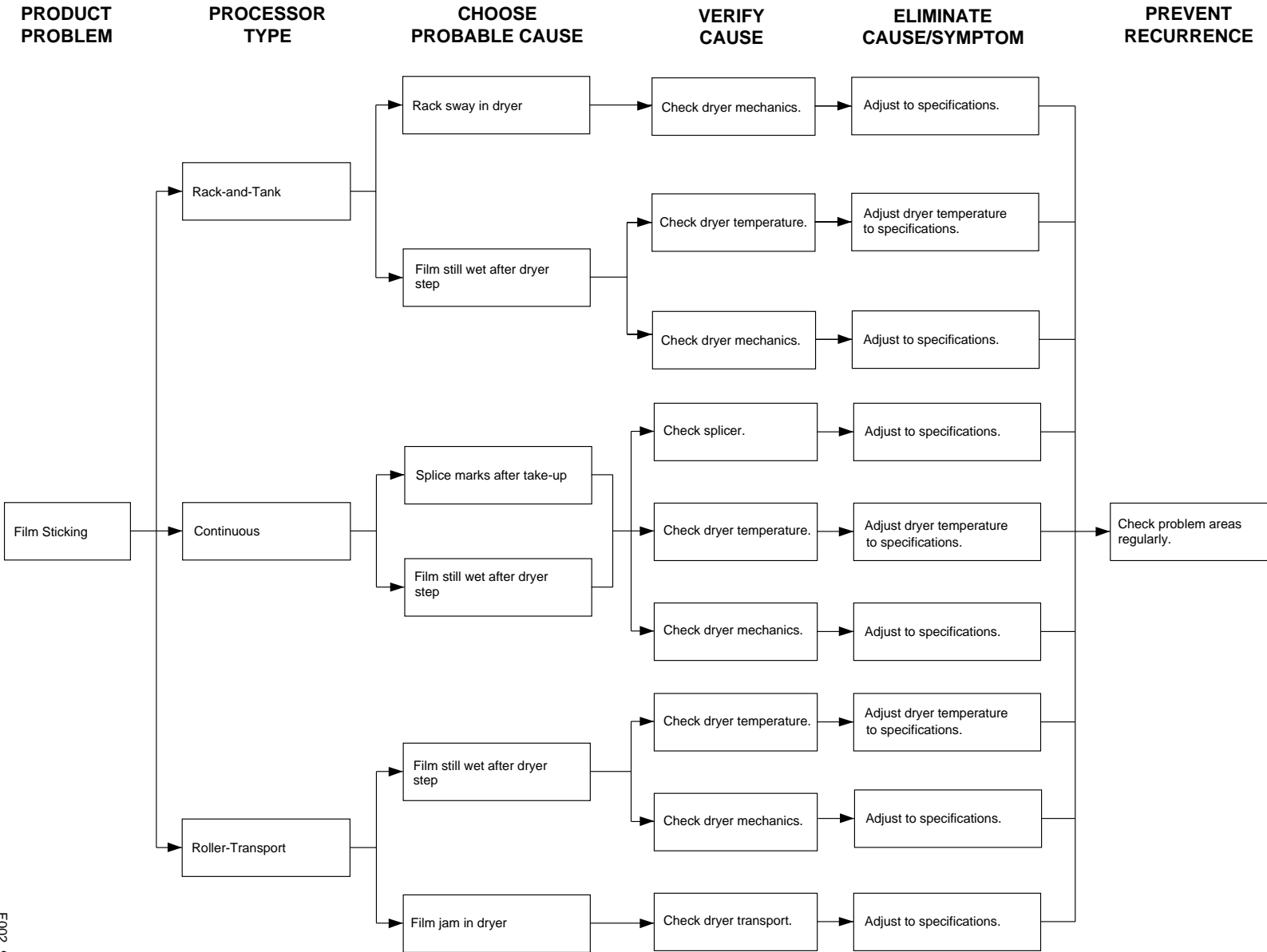


**Chart Q**

Visual Appearance—Film—Pressure Marks, Fog, Static



\*If possible, perform all operations in areas that are conditioned at 45 to 65 percent relative humidity and 18 to 24°C (65 to 75°F). Keep the splicing, film-loading, and processing rooms as dust-free as possible. Provide a good electrical ground on your splicing equipment.  
Do not handle film any more than is necessary. Avoid sudden, quick movements of the film that could cause friction. Avoid winding or unwinding roll film too tightly or too rapidly.



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## Troubleshooting Solution-Foaming Problems in Process C-41

Foaming of process solutions can have an adverse effect on the quality of processed films, and can lead to solution contamination. If foaming is severe in any process solution, check the following:

1. Make sure that no air is being drawn into the tank solution through the recirculation system. Air drawn into the recirculation system produces very fine bubbles, which promote foaming and misting of solutions. Check for pinhole leaks in the line, a filter pod that is not sealed, or a loose fitting. With a rack-and-tank processor, make sure that the gaseous-burst agitation system is shut off when you check for these problems.
2. In rack-and-tank processors, make sure that the bubbles used for agitation are approximately 4 mm in diameter (“pea-sized” bubbles). Bubbles that are too small can promote foaming and misting of solutions. Small bubbles usually result from sparger holes that are too small or from holes that are restricted by chemical residue. To reduce the tendency for residue to build up in sparger holes in the developer tank, make sure to use humidified nitrogen of at least 99-percent purity.

**Note:** When cleaning the burst sparger to remove residue, be careful not to enlarge the holes by using a tool that is too large. Enlarged holes will produce large bubbles that can cause solution splashing at the top of the tank.

3. In rack-and-tank processors, make sure that the pressure of the burst agitation causes a maximum solution rise of approximately 5/8 inch (1.5 cm). Too much pressure will make the solution rise excessively, creating more potential for solution foaming.
4. In rack-and-tank processors with small tanks, the developer tank has an increased tendency to foam when you use FLEXICOLOR Developer Replenisher LORR. Try switching to the standard FLEXICOLOR Developer Replenisher to reduce foaming (and be sure to increase the developer replenishment rate accordingly).

As a last resort to reduce solution foaming in Process C-41, use KODAK Defoamer, Process E-6 (CAT No. 125 3566) according to the following directions:

1. Use the defoamer sparingly. Use a clean cotton swab to apply a thin coating on only two sides of the tank. Apply the defoamer at least 1/2 inch to 1 inch above the maximum solution level. With a rack-and-tank processor, the maximum solution level is the highest solution level reached during a burst agitation cycle.

**Note:** *The defoamer should not come into direct contact with the process solution.* If the defoamer enters the solution, it can cause “oily” deposits or process restriction marks on film.

2. At processor start-up each day, remove the old defoamer from the sides of the tank(s) with a clean damp cloth, and reapply defoamer as in described in step 1.

## CONTROL-CHART EXAMPLES

The following charts are examples of how various conditions will affect your control plots. They are intended *only as a guide*; your plots may not look exactly like these examples. Your plots may be different because of processor and control-strip differences and your processing conditions. More than one problem may also be affecting your process.

These plots are typical for a particular problem; however, if they do not exactly match your plots, find the one that most closely matches the predominant trend. Use these charts, along with the diagnostic charts and the information under *Interpreting Your Control Plot* to analyze process problems.

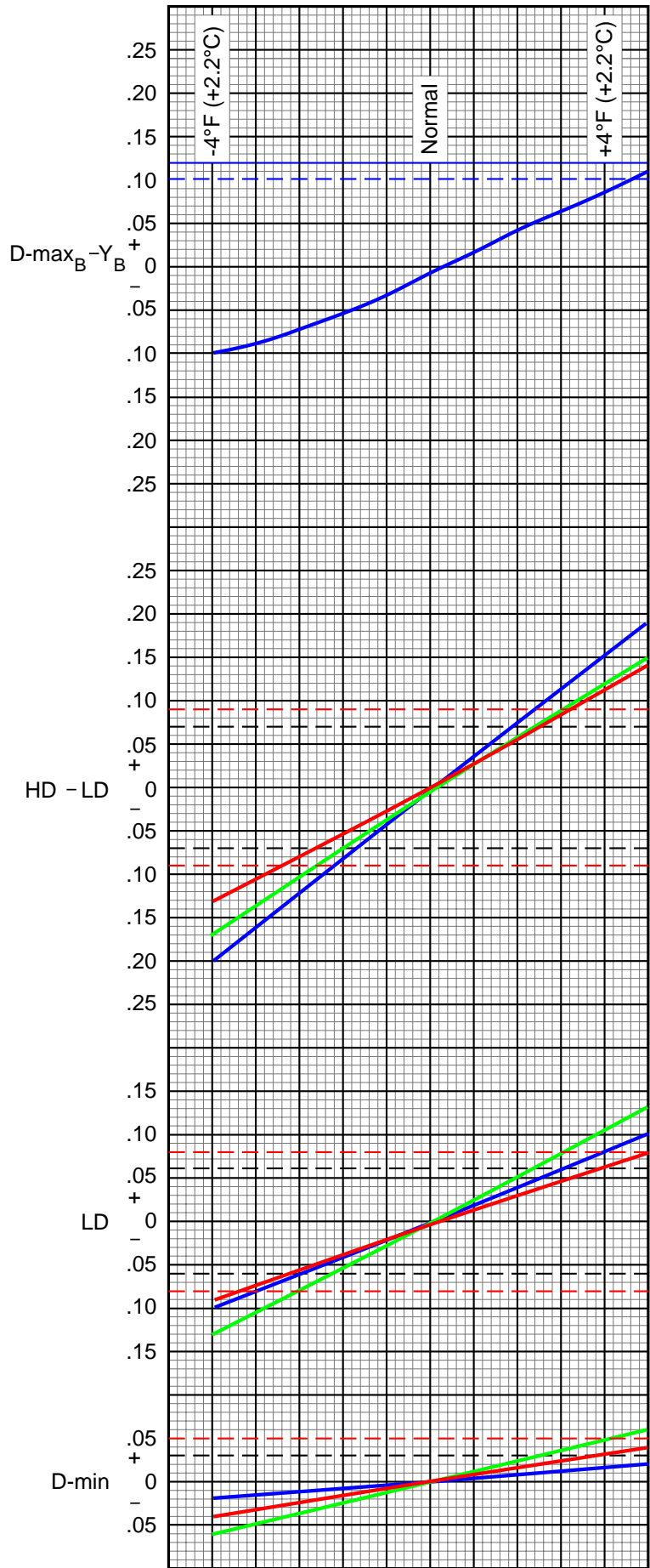
Chart	Solution	Condition
1	Developer	Temperature Too Low/High
2	Developer	Time Too Short/Long
3	Developer	Agitation Too Low/High
4	Developer Replenisher LORR	Replenishment Rate Too Low/High
5	Developer Replenisher	Replenishment Rate Too Low/High
6	Developer	Mix Error—Too Little/Much Part A
7	Developer	Mix Error—Too Little/Much Part B
8	Developer	Mix Error—Too Little/Much Part C
9	Developer Starter LORR	Fresh-Tank Mix Error—Too Little/Much
10	Developer Starter	Fresh-Tank Mix Error—Too Little/Much
11	Developer	Tank Solution Concentration — Too Low/High
12	Developer	Oxidation
13	Developer	Contaminated with Bleach
14	Developer	Contaminated with Fixer
15	Bleach III	Too Dilute
16	Bleach III	Replenishment Rate Too Low
17	RA Bleach	Replenishment Rate Too Low/High
18	Bleach III	Poor Aeration
19	RA Bleach	Poor Aeration
20	Bleach	Stain
21	Fixer	Too Dilute
22	Fixer	pH Too Low

**Developer—  
Temperature Too Low/High**

Developer activity varies directly with temperature. High temperatures will increase the amount of dye formed; low temperatures will decrease the amount of dye formed. Check the developer temperature daily with an accurate thermometer. Check your temperature control unit daily.

Out-of-control conditions due to temperature changes are difficult to solve. They can appear and disappear rapidly because they are usually caused by intermittent electrical or tempered-water-flow problems. Poor tank recirculation can also cause temperature problems; insufficient dye will form when the temperature is not maintained uniformly throughout the tank. Check the developer temperature with an accurate thermometer if your temperature-control unit indicates fluctuations.

**Chart 1**



## Developer— Time Too Short/Long

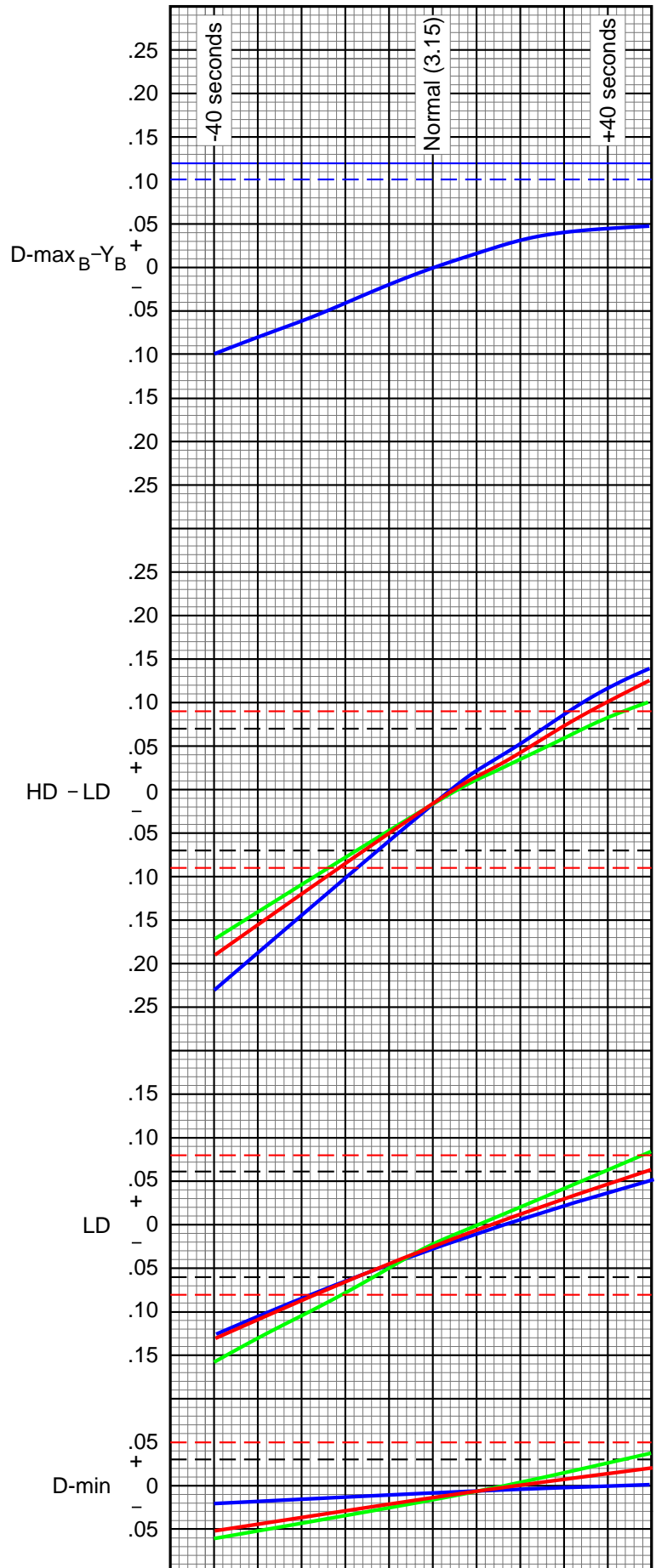
Developer activity varies directly with time. An increase in developer time produces an increase in the amount of dye formed; a decrease in developer time produces a decrease in the amount of dye formed.

Developer time variations can occur in processors because of electrical-load variations and motor-temperature differences from a cold start to normal operation. Electrical-load differences can be caused by other equipment, such as a heater on the same power line. In some cases, you may need a voltage regulator on the drive motor to compensate for external voltage variations.

Mechanical problems, such as misaligned moving parts, can cause developer-time problems. Be sure that the transport is functioning properly. Use a stopwatch to measure the developer time, and compare it with the machine setting.

Developer-time problems occur in manual processes in sink lines, small tanks, or rotary-tube processors because of operator error. Minimize errors by establishing reproducible techniques. Watch the timer closely, and make sure to allow the recommended drain time as part of the developer time.

**Chart 2**



## Developer— Agitation Too Low/High

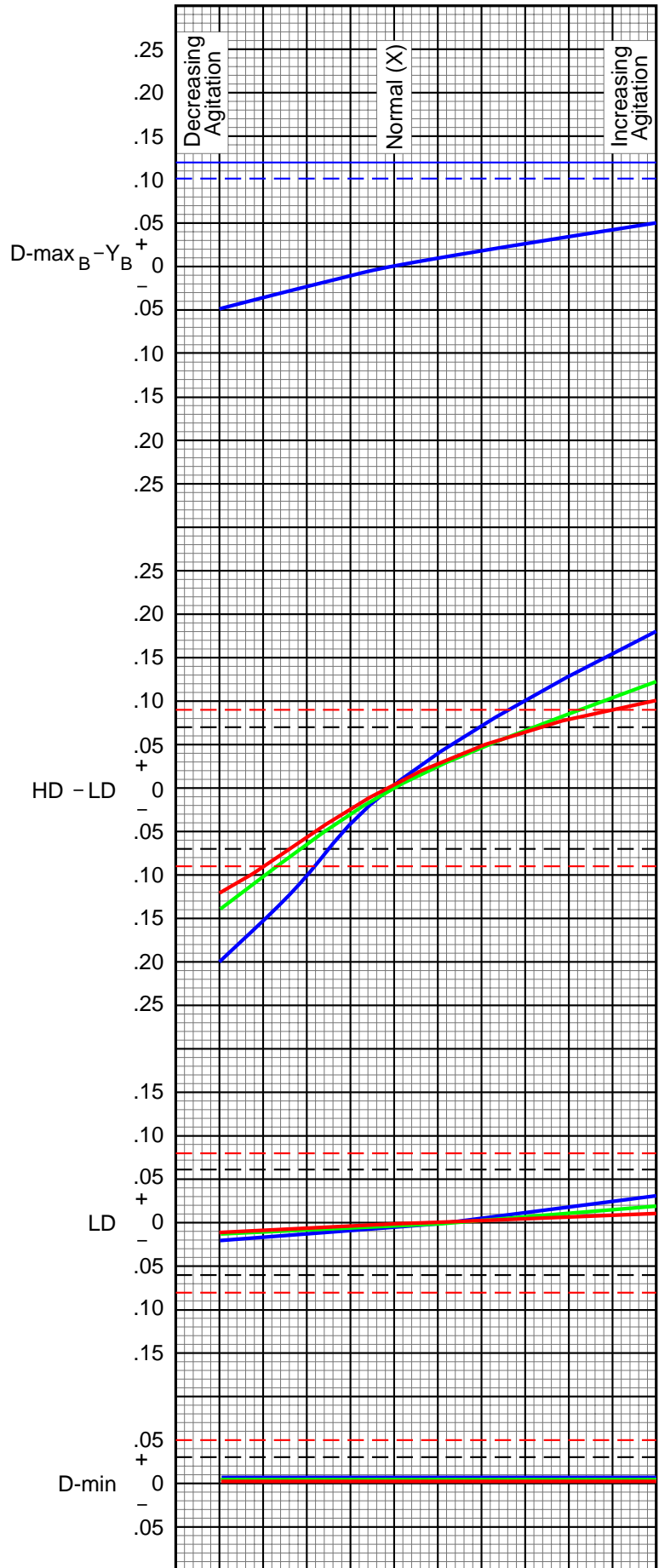
Agitation aids in removing developer by-products from the film so that fresh developer can diffuse into the emulsion. An increase in agitation increases the amount of dye formed. Poor agitation does not allow enough development, resulting in low and non-uniform densities. Fluctuations in agitation have the greatest effect on high densities.

Agitation is more likely to be a problem in manual processes such as sink lines, small tanks, and rotary-tube processors. To minimize agitation problems in manual processes, follow all recommendations carefully.

In rack-and-tank processors, developer agitation is provided by bursts of nitrogen or a recirculation system. Agitation must be sufficient and uniform to provide even development. A kinked recirculation line or plugged sparger can hinder agitation, causing underdevelopment. If agitation is excessive, oxidation and foaming in the developer will occur. For nitrogen-burst agitation, we recommend a 10-second cycle that consists of one 2-second burst followed by an 8-second rest. Use enough pressure to raise the solution level 1.5 cm ( $\frac{5}{8}$  in.). The pressure should provide vigorous bursts that cover all areas of the tank in a uniform pattern without splashing. Check that your recirculation system is also operating properly.

In continuous processors, agitation is provided by a recirculation system. A kinked recirculation line or a plugged distributor bar can hinder agitation, causing underdevelopment. Also check the recirculation pumps to be sure they are working within specifications set by the manufacturers.

### Chart 3



## Developer Replenisher LORR— Replenishment Rate Too Low/High

Developer activity varies directly with the developer replenishment rate. An overreplenished developer will produce high dye densities; an underreplenished developer will produce low dye densities. You will see the effects of over- and underreplenishment in all of the control-plot densities.

How quickly your control plots indicate an incorrect replenishment rate depends on the tank volume, the machine speed, and the amount of film processed. Recheck the average film production that you use to calculate the replenishment rate. Check the flowmeter or pump setting manually as described in the processor manual; adjust it if necessary. See Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*, for starting-point developer replenishment rates. For minilabs, see Section 4, *Minilab Processors*.

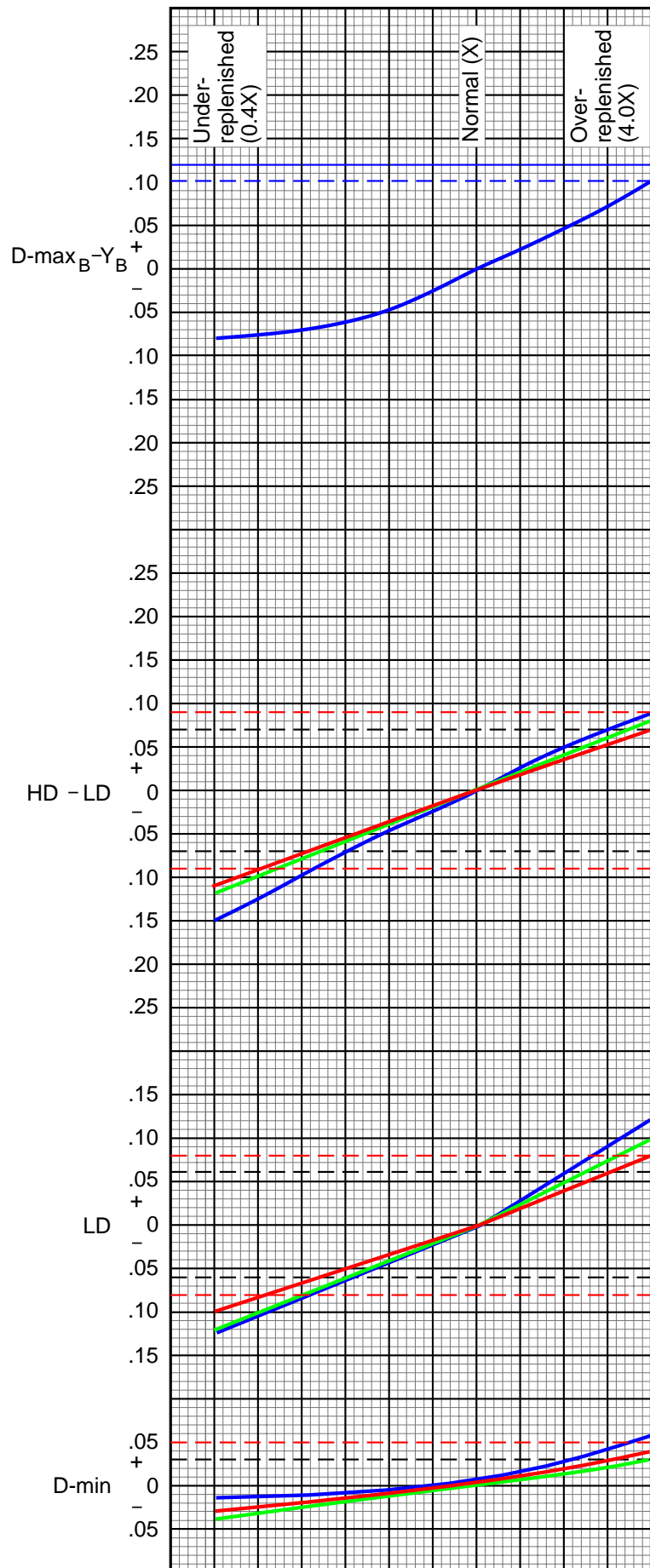
Developer replenishment rates supplied for each process are based on average exposures. Check your production; if it appears that the film has more or less density than usual, adjust your developer replenishment rate.

If overreplenishment is confirmed, adjust the developer tank solution by adding a solution of one part FLEXICOLOR Developer Starter LORR to four parts water. Add 25 mL of this mixture per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If high activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

If underreplenishment is confirmed, adjust the developer tank solution by adding 25 mL of a properly mixed developer replenisher LORR per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If low activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

Be sure that you do not add starter or replenisher solution close to the overflow, or you will lose the effect of the addition if it is lost to the overflow. Turn the recirculation on, and allow the developer to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition until the process plots within the control limits.

**Chart 4**





## Developer Replenisher— Replenishment Rate Too Low/High

Developer activity varies directly with the developer replenishment rate. An overreplenished developer will produce high dye densities; and underreplenished developer will produce low dye densities. You will see the effects of over- and underreplenishment in all of the control-plot densities.

How quickly your control plots indicate an incorrect replenishment rate depends on the tank volume, the machine speed, and the amount of film processed. Recheck the average film production that you use to calculate the replenishment rate. Check the flowmeter or pump setting manually as described in the processor manual; adjust it if necessary. See Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*, for starting-point developer replenishment rates. For minilabs, see Section 4, *Minilab Processors*.

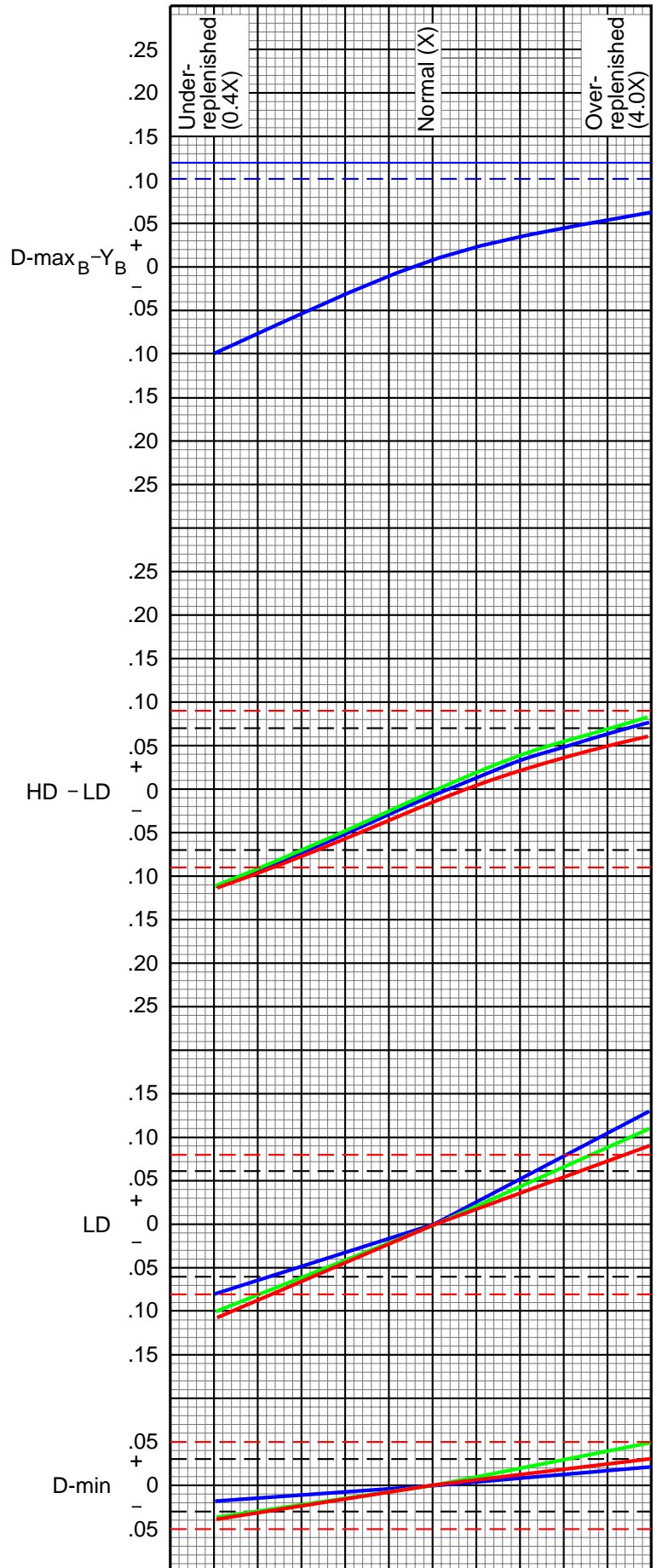
Developer replenishment rates supplied for each process are based on average exposures. Check your production; if it appears that the film has more or less density than usual, adjust your developer replenishment rate.

If overreplenishment is confirmed, adjust the developer tank solution by adding a solution of one part FLEXICOLOR Developer Starter to nine parts water. Add 25 mL of this mixture per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If high activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

If underreplenishment is confirmed, adjust the developer tank solution by adding 50 mL of a properly mixed developer replenisher per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If low activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

Be sure that you do not add starter or replenisher solution close to the overflow, or you will lose the effect of the addition. Turn the recirculation on, and allow the developer to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition until the process plots within the control limits.

### Chart 5



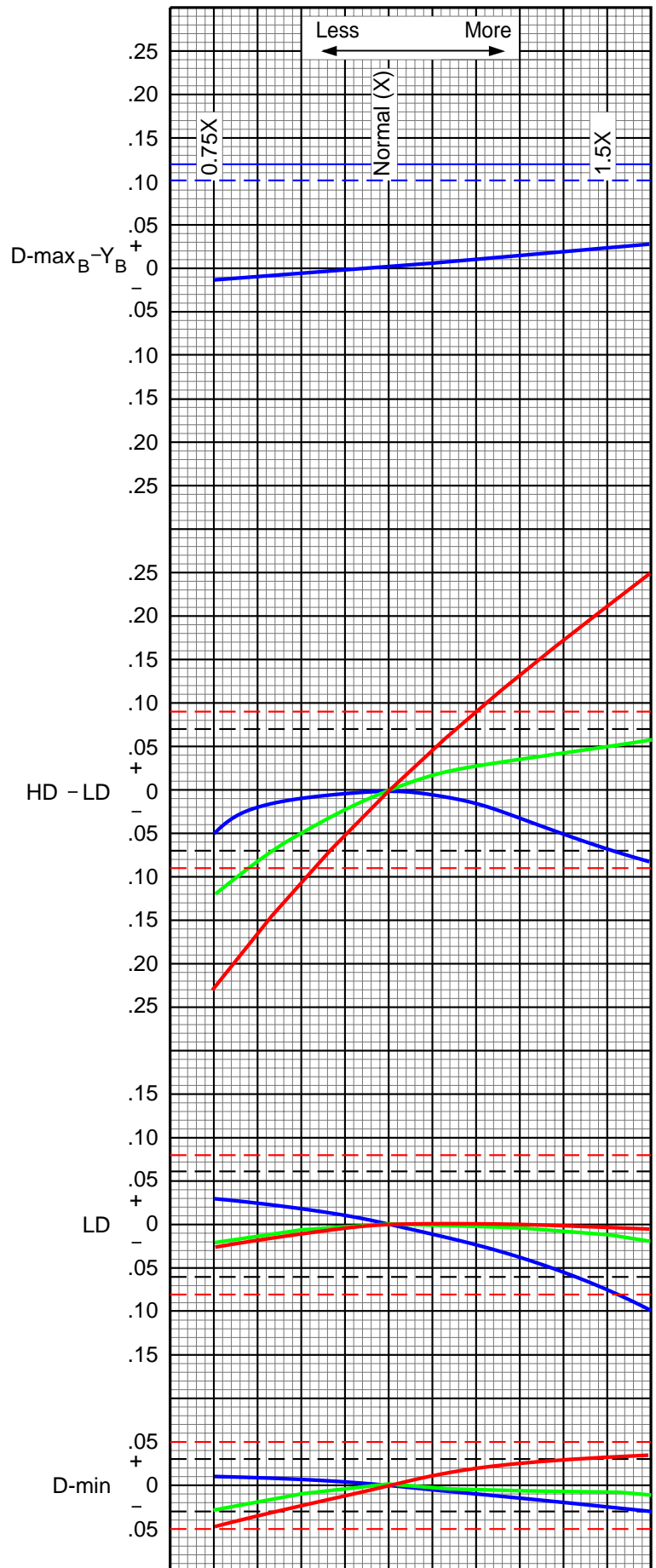
## Developer—

### Mix Error—Too Little/Much Part A

Using an incorrect amount of Part A to prepare developer tank solution has the greatest effect on the high red densities. In the HD – LD plot, the red density will increase dramatically when you use too much Part A; the red density plot will decrease if you do not use enough Part A. The green density will behave in a similar manner, but to a lesser degree. However, the blue density plot will decrease when you use too much or too little Part A.

Check your mixing procedures. Unless you know the incorrect amount of Part A used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

### Chart 6



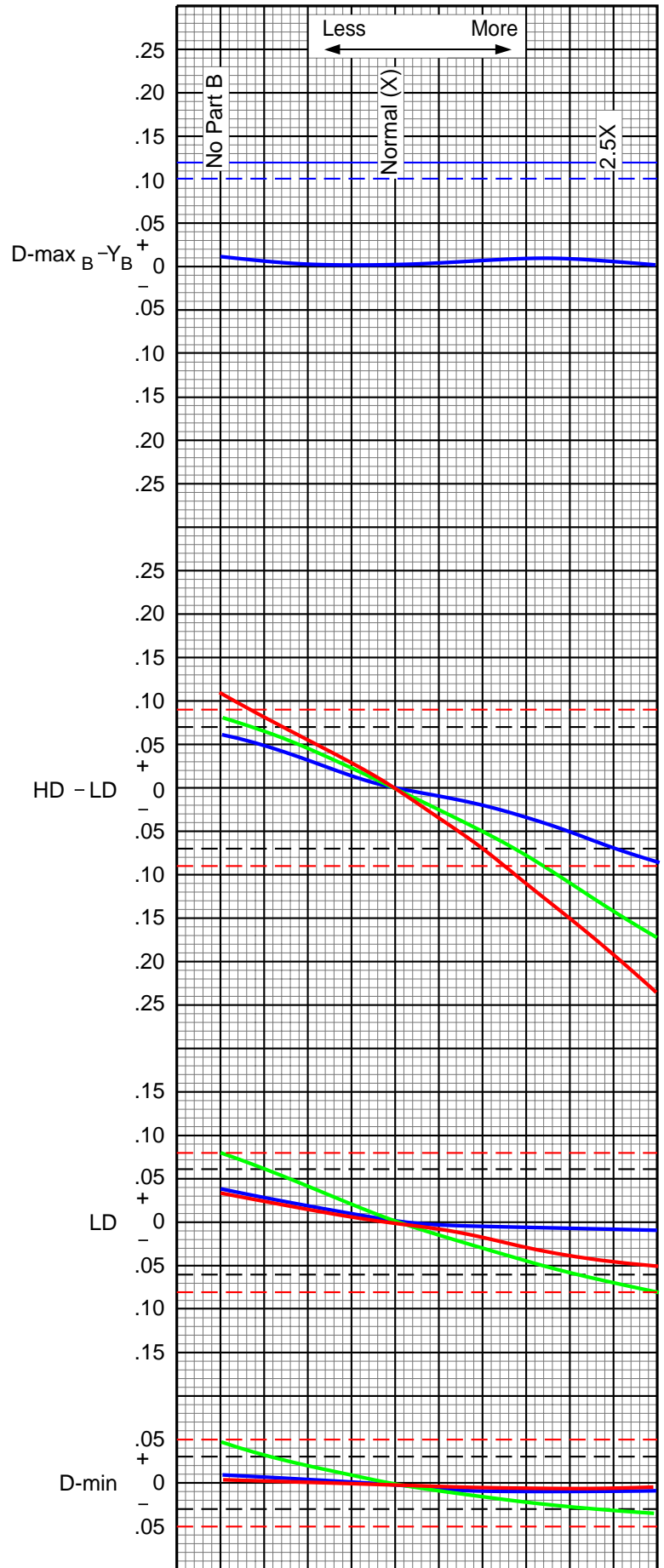
## Developer—

### Mix Error—Too Little/Much Part B

Developer activity varies inversely with the amount of Part B used to prepare developer tank solution. If the solution is prepared with too little Part B, developer activity will increase and more dye will form. If the solution is mixed with too much Part B, developer activity will decrease and less dye will form. The densities of the HD – LD plot will show the greatest effects of an incorrect amount of Part B.

Check your mixing procedures. Unless you know the incorrect amount of Part B used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

### Chart 7



## Developer—

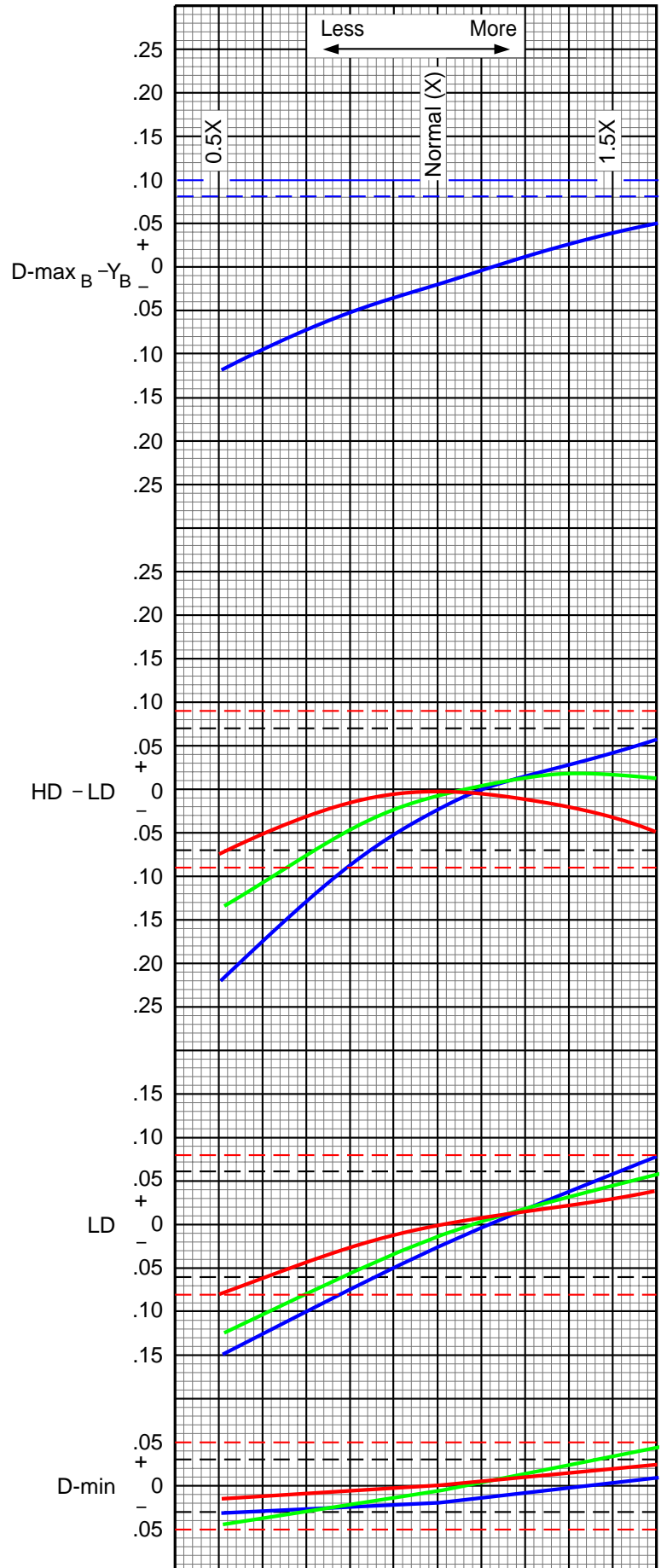
### Mix Error—Too Little/Much Part C

Developer activity varies directly with the amount of Part C used to prepare developer tank solution. If the solution is prepared with too little Part C, developer activity will decrease and less dye will form. If the solution is prepared with too much Part C, developer activity will increase and more dye will form.

The blue density of the HD – LD plot will show the greatest effects of an incorrect amount of Part C used. If an insufficient amount of Part C is used, the red, green, and blue HD – LD densities will be too low. If too much Part C is used, the green and blue densities will increase.

Check your mixing procedures. Unless you know the incorrect amount of Part C used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

### Chart 8



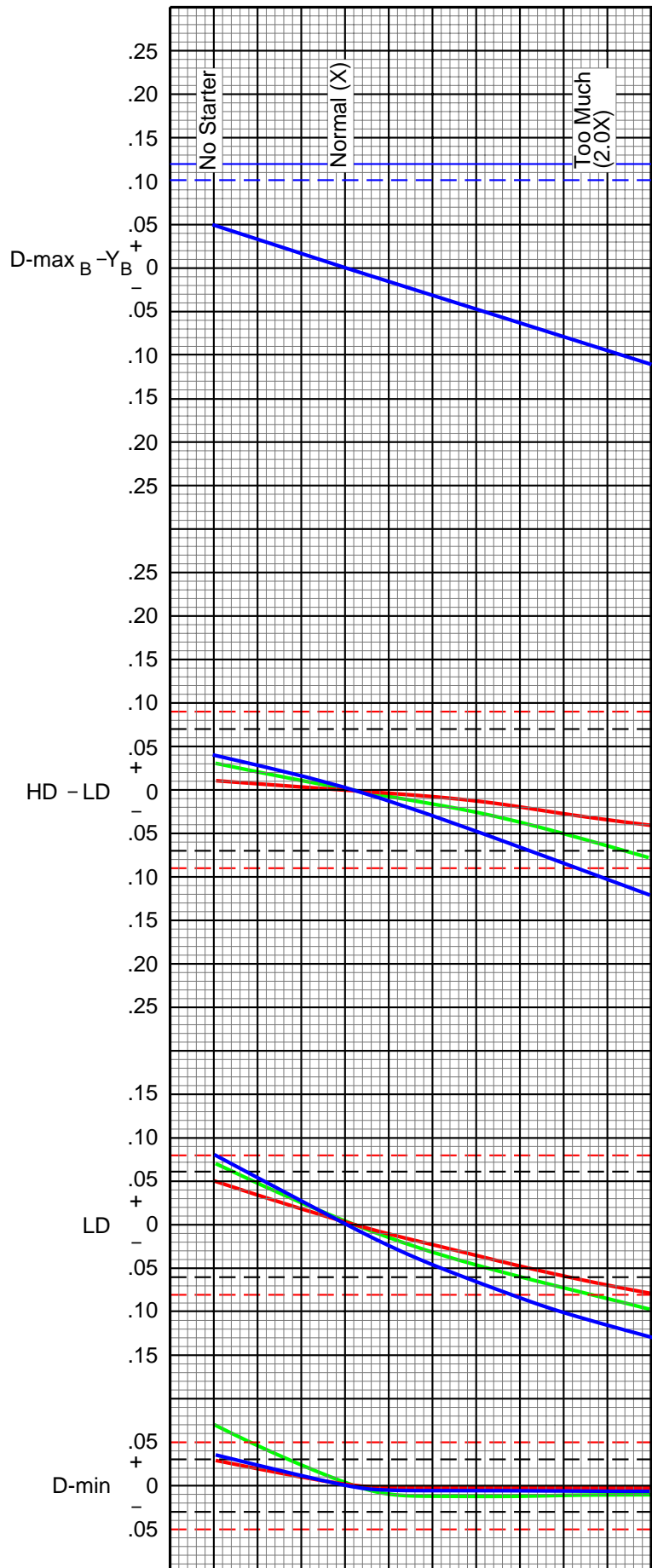
## Developer Starter LORR— Fresh-Tank Mix Error—Too Little/Much

Developer activity varies inversely with the amount of developer starter used to prepare a fresh tank solution. Too much starter results in low dye formation; too little starter results in high dye formation.

If you know the problem is high developer activity caused by adding too little FLEXICOLOR Developer Starter LORR to fresh developer tank solution, add developer starter LORR to the tank solution in 11 mL/L increments until the control-plot densities indicate that the process is within control limits. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip.

If you know the problem is low developer activity caused by adding too much FLEXICOLOR Developer Starter LORR to the developer tank solution, add 39 mL of developer replenisher LORR and 13 mL of water per litre of developer tank solution. Be sure that you do not add the solution close to the overflow or you will lose the effect of the addition. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition if necessary.

**Chart 9**



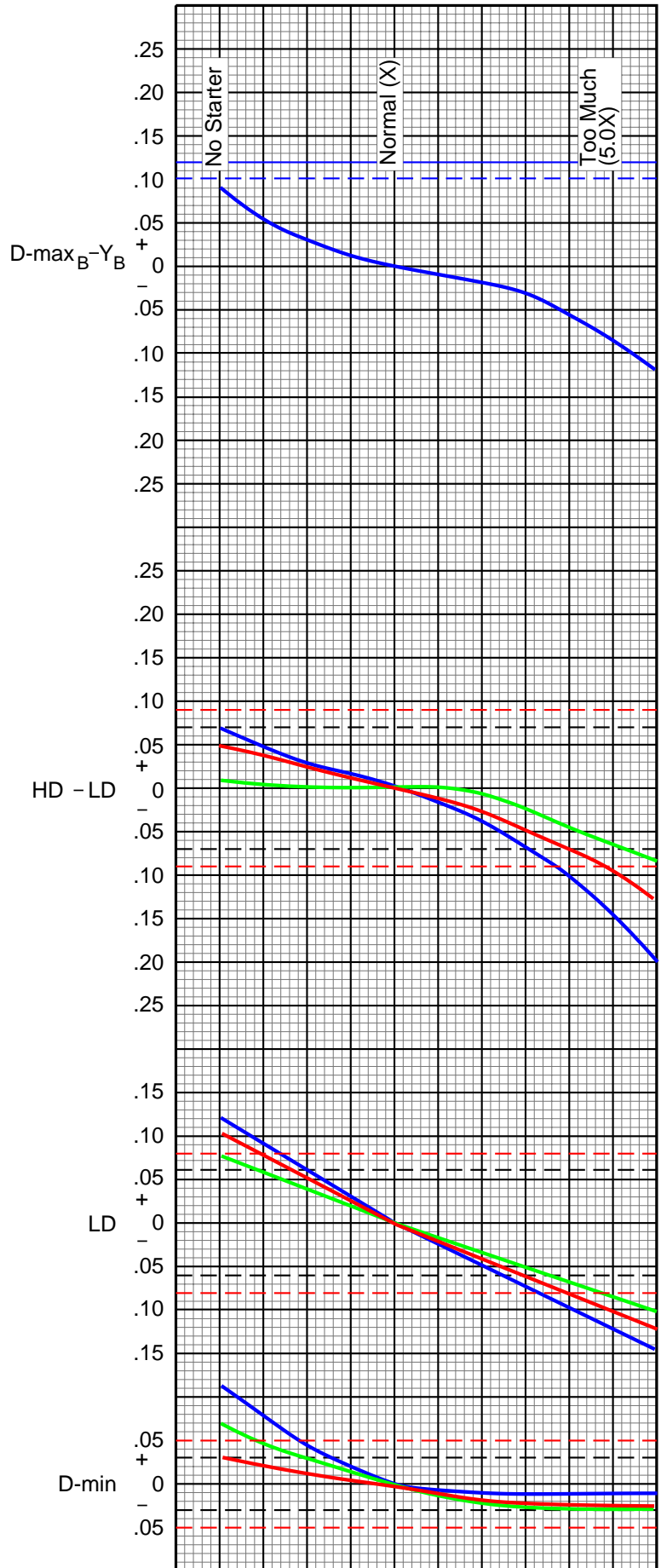
**Developer Starter—  
Fresh-Tank Mix Error—Too Little/Much**

Developer activity varies inversely with the amount of developer starter used to prepare a fresh tank solution. Too much starter results in low dye formation; too little starter results in high dye formation.

If you know the problem is high developer activity caused by adding too little FLEXICOLOR Developer Starter to fresh developer tank solution, add developer starter to the tank solution in 5.5 mL/L increments until the control-plot densities indicate that the process is within control limits. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip.

If you know the problem is low developer activity caused by adding too much FLEXICOLOR Developer Starter to the developer tank solution, add 43.6 mL of developer replenisher and 6.4 mL of water per litre of developer tank solution. Be sure that you do not add the solution close to the overflow, or you will lose the effect of the addition. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition if necessary.

**Chart 10**



**Developer—  
Tank Solution Concentration—  
Too Low/High**

When you prepare a fresh developer tank solution, the amount of water you use affects the developer concentration. If you use too much water, the developer will be diluted and dye density will be low. If you do not use enough water, the developer will be overconcentrated and dye density will be high.

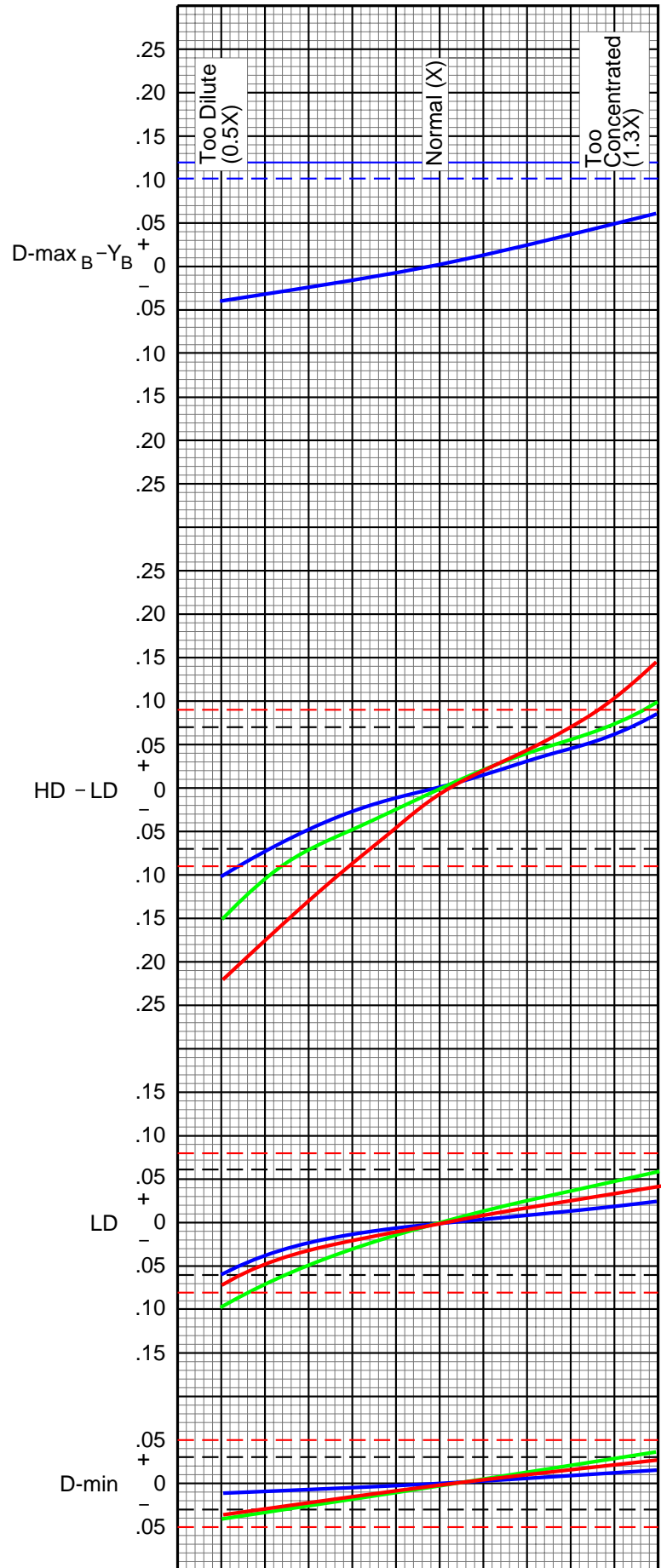
If you know that your process is out of control because the developer tank solution is diluted, replace the tank solution.

If your control plot indicates that the tank solution is overconcentrated, you can add water to the developer tank to bring the plots within tolerance. However, unless you know the amount of water that was omitted, **do not** add more than 5 percent of the total tank volume to correct the concentration.

In seasoned tank solutions, evaporation causes increased developer concentration and dye density. This is especially true in low-utilization operations. Be sure to top off your tank solution with water daily at start-up.

You can monitor the concentration of your developer tank solution by making specific-gravity measurements with a hydrometer (see *Check Your Mixes with Specific-Gravity Measurements* in Section 1, *KODAK FLEXICOLOR Chemicals*).

**Chart 11**



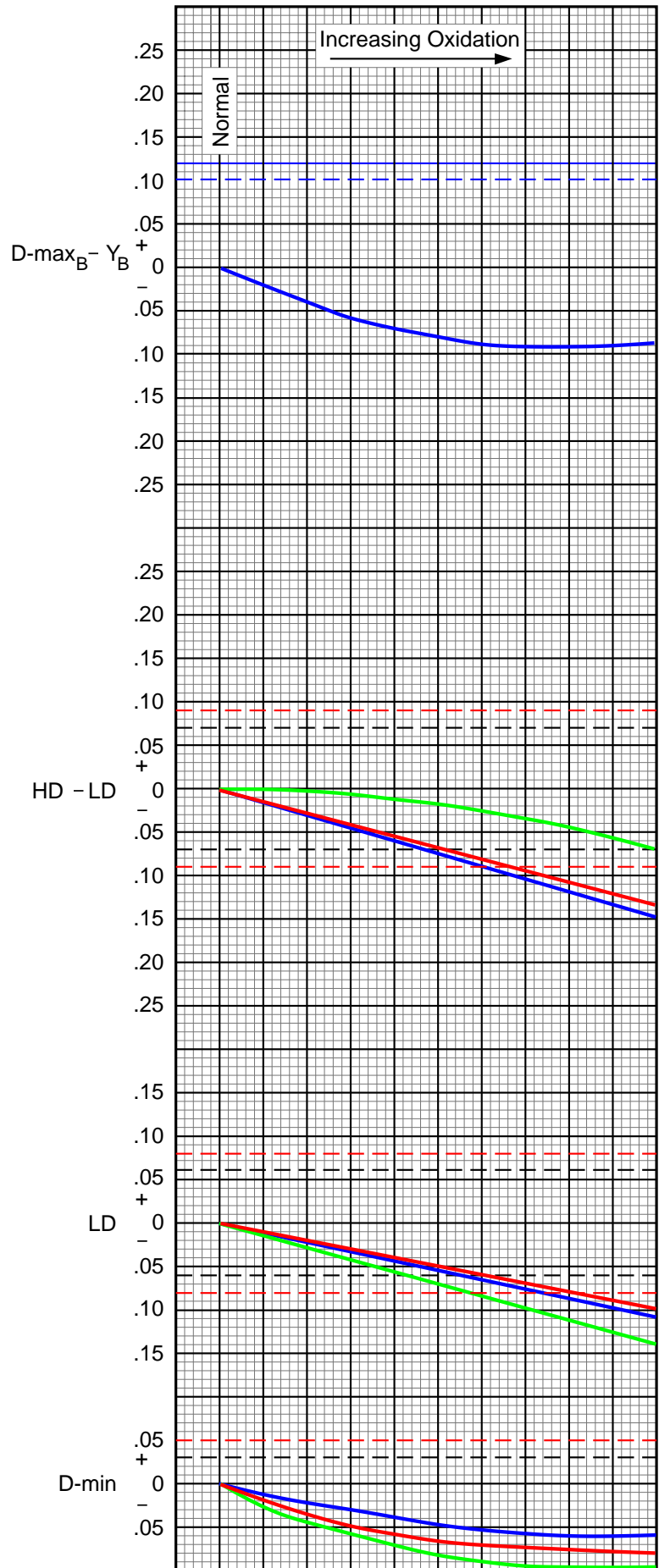
## Developer— Oxidation

Developer activity can be affected by oxidation of the solution. Increasing developer oxidation causes less dye to form, lowering density values.

Use floating lids on all developer replenisher tanks. By protecting the developer replenisher from contact with air, you can avoid problems caused by aerial oxidation. Oxidation will occur during idle periods when the processor is up to temperature but is not processing film. This problem will be most noticeable in roller-transport and minilab processors with low utilization. You should be able to avoid severe oxidation problems in most processors by ensuring that at least one developer tank turnover occurs every 4 weeks.

Leaks in a recirculation line or fitting will allow air to bubble into the tank solution, causing oxidation. Check your equipment for leaks if oxidation occurs. Excessive gaseous-burst agitation in rack-and-tank processors can also oxidize the developer.

**Chart 12**





## Developer— Contaminated with Bleach

Very small amounts of bleach will contaminate the developer and affect developer activity. The D-min and LD densities will increase because more dye forms due to chemical “fogging.” The HD – LD plots will decrease with more contamination.

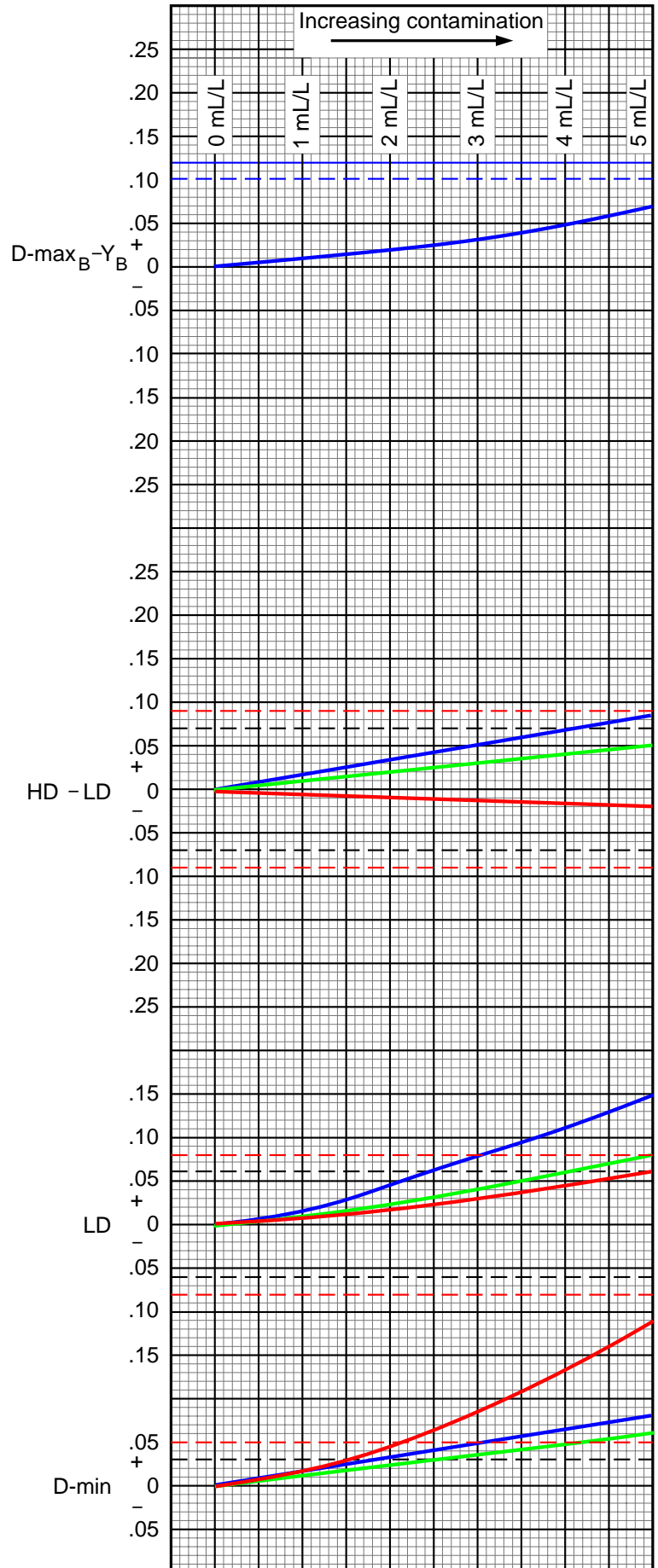
Use different mixing tanks when you prepare developer and bleach replenisher solutions. If bleach aeration is excessive, misting or splashing of the bleach can occur and slowly contaminate the developer tank.

In minilab processors, bleach can splash back into the developer as the leader card and film emerge from the bleach. The developer can also be contaminated by bleach complexes that have deposited onto the leader card. Clean all leader cards thoroughly each day at shutdown; you may need to soak them in hot water to remove the bleach. Replace worn or damaged leader cards.

Make sure that bleach does not drip into the developer when you remove the bleach racks for cleaning, maintenance, etc.

If bleach contamination occurs, stop processing customer film. After you locate and eliminate the source of contamination, dump the developer tank solution, rinse the tank thoroughly, and mix a fresh developer tank solution.

### Chart 13



**Developer—  
Contaminated with Fixer**

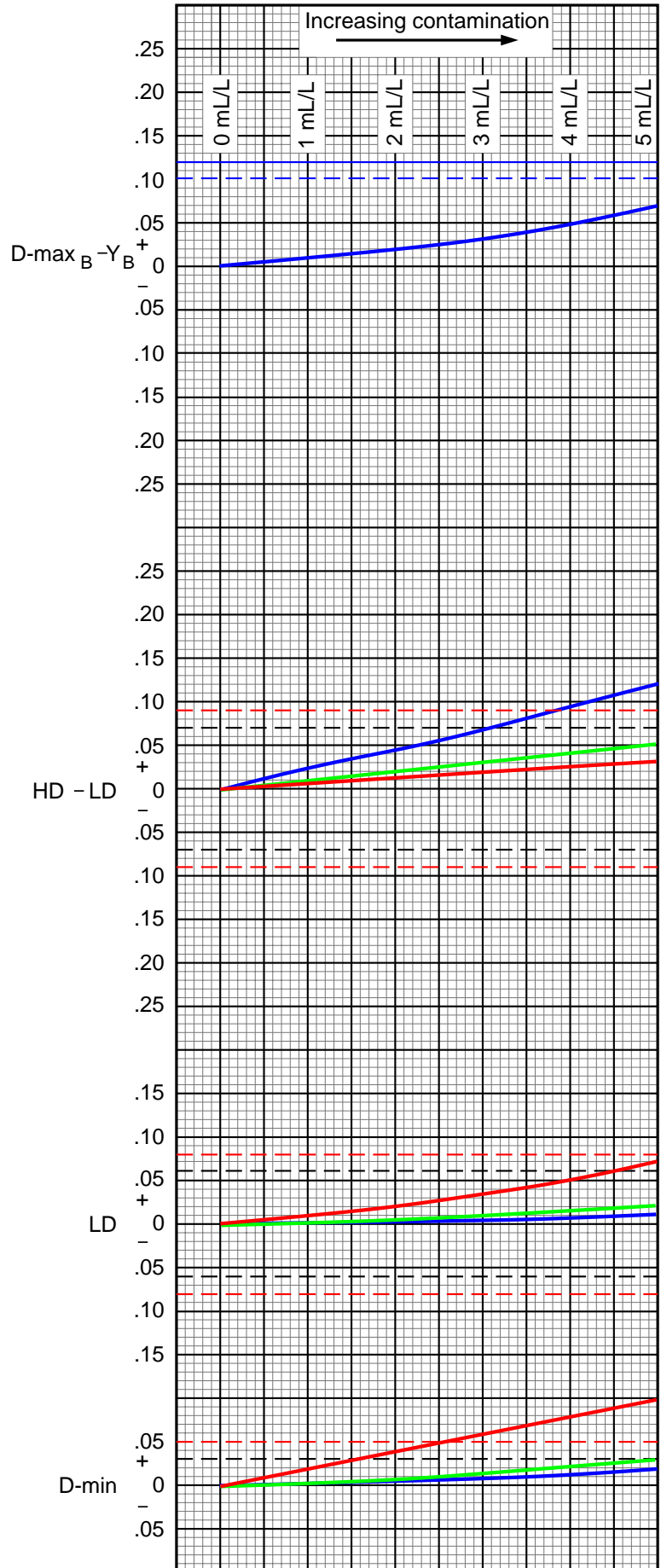
Very small amounts of fixer will contaminate the developer and cause chemical “fogging.” As contamination increases, dye density will increase in all of the control-chart plots. Fixer contamination is most noticeable as an increase in HD – LD and in the red D-min density.

Use different mixing tanks when you prepare developer and fixer replenisher solutions; minute amounts of fixer can contaminate the developer.

In minilab processors, fixer contamination of the developer usually occurs from leader cards that are not thoroughly clean. Clean all leader cards thoroughly in hot water each day at shutdown. Replace worn or damaged leader cards.

If fixer contamination occurs, stop processing customer film. After you locate and eliminate the source of contamination, dump the developer tank solution, rinse the tank thoroughly, and mix a fresh developer tank solution.

**Chart 14**



### Bleach III— Too Dilute

If the bleach solution is too dilute, bleach activity is reduced, causing retained silver in the HD and D-max regions.

A dilute bleach tank can be caused by excessive developer carryover or a mix error. Be sure that your squeegees are working properly to minimize developer carryover. Check for mix errors in your bleach replenisher or bleach working tank.

If you suspect that a diluted bleach solution is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the  $D\text{-max}_B - Y_B$  and HD - LD plots, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a known good bleach and then completing the remaining processing steps. To test for retained silver, follow the procedure given in *Appendix A*.

If you know the problem was caused by a bleach tank solution that is too dilute, add the amount of Part A, Part B, and starter shown in Table 5-3 for each litre of tank solution.

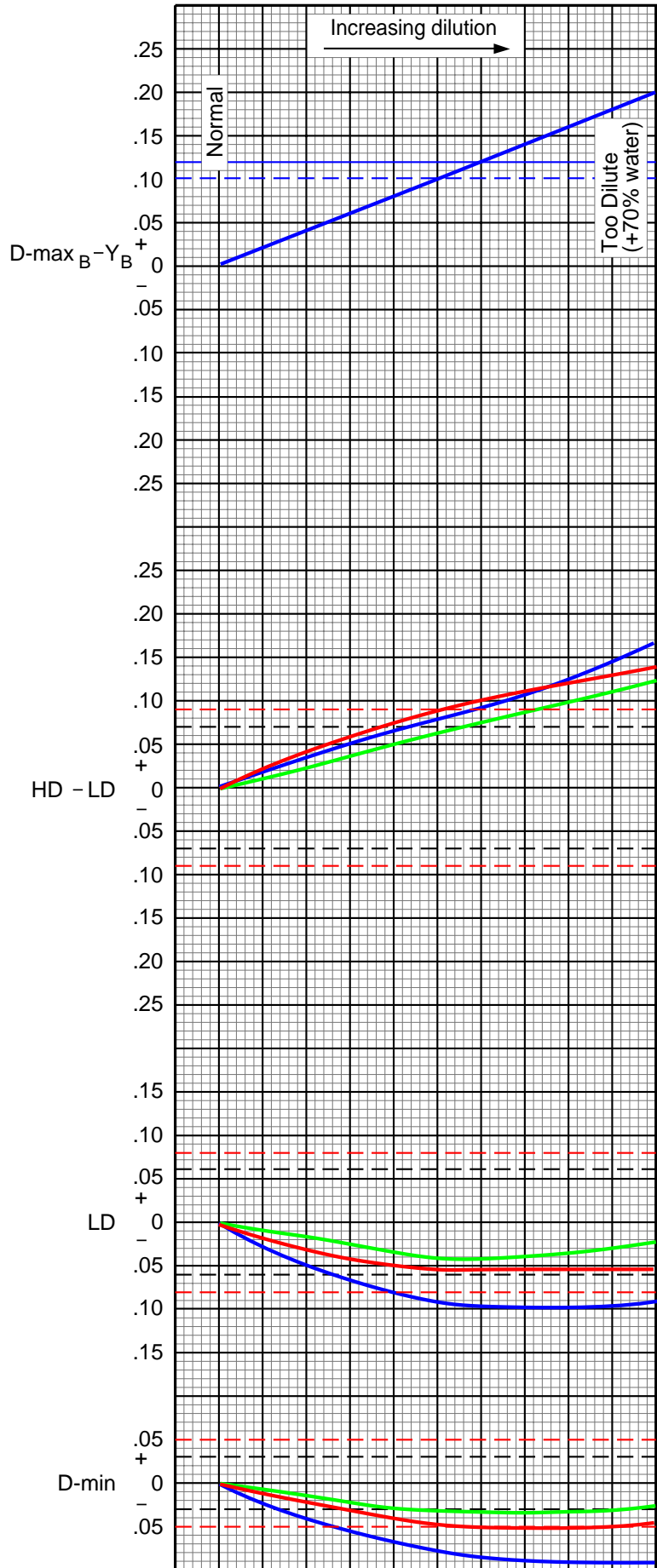
**Table 5-3**

	Bleach III Regenerator	Bleach III NR Replenisher
Concentrate	30 mL	35 mL
Starter	15 mL	13 mL

You may need to make more than one addition. Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. If, after several additions, retained silver is still a problem, replace the bleach tank solution.

If the bleach replenisher was severely diluted with water, replace it with a fresh mix.

### Chart 15



### Bleach III— Replenishment Rate Too Low

A low bleach replenishment rate does not adequately compensate for developer carryover. This can reduce bleaching activity by diluting the bleach and raising the pH, causing retained silver. This is most noticeable as elevated plots in  $D\text{-max}_B - Y_B$  and  $HD - LD$ .

If you believe a problem is caused by incorrect replenishment, check the replenishment-rate setting, and reset it if necessary. Also check the developer exit squeegees to make sure they are efficient in limiting developer carryover.

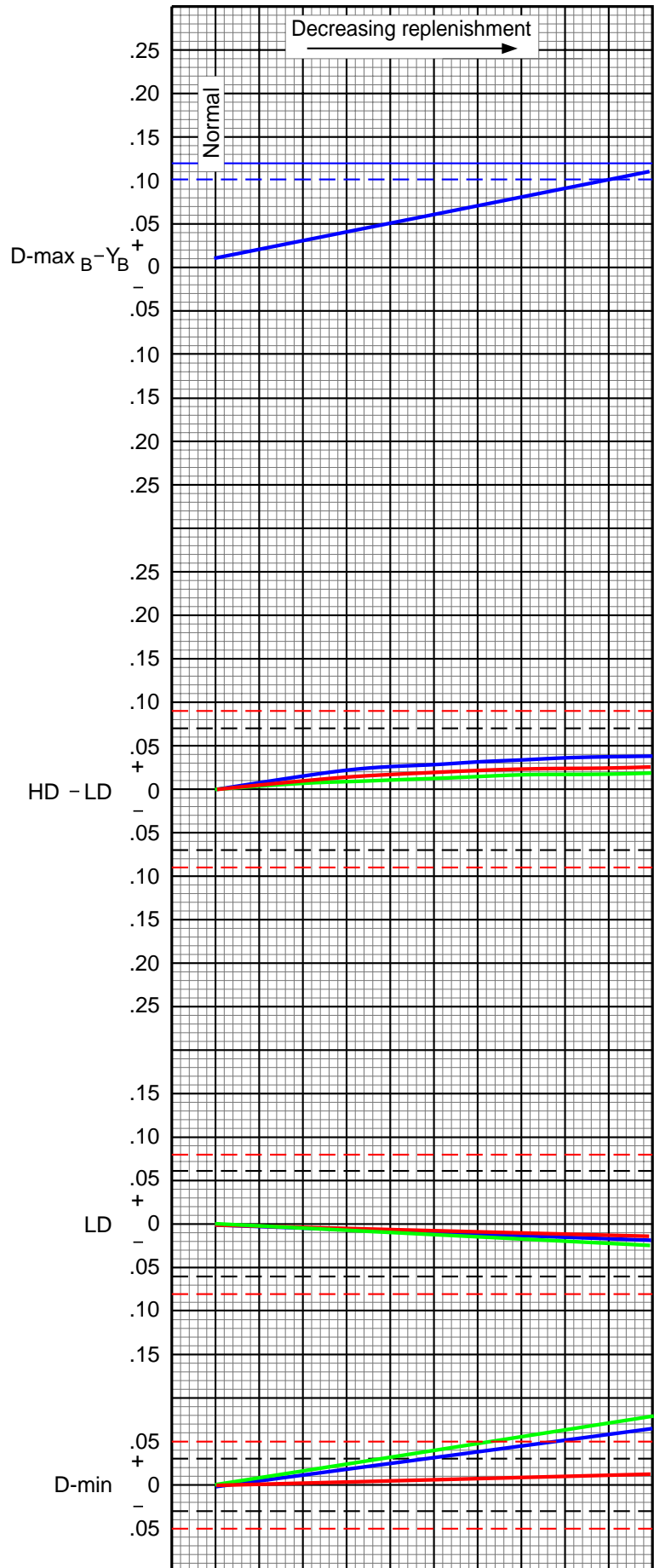
If you have verified that retained silver is the problem (by rebleaching or checking with an infrared scope) and it was *not caused by inadequate aeration*, add the amount of Parts A and B shown in Table 5-4 for each litre of tank solution.

**Table 5-4**

	Bleach III Regenerator	Bleach III NR Replenisher
Concentrate	30 mL	35 mL

Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. Repeat these additions until your control strips no longer have retained silver.

### Chart 16



## RA Bleach— Replenishment Rate Too Low/High

Bleach activity is affected by improper replenishment. An underreplenished bleach solution will not adequately compensate for developer carryover. The pH of the bleach will increase and total iron will decrease, causing retained silver.

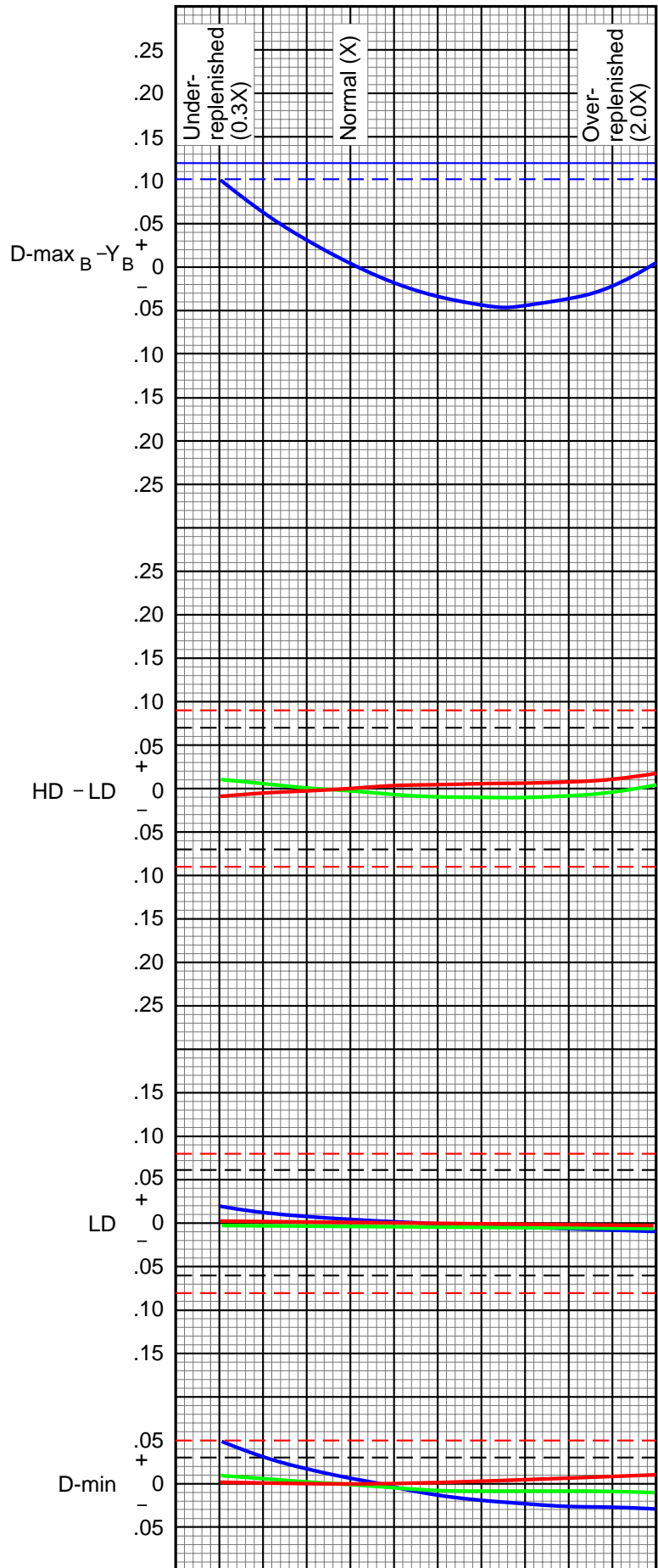
An underreplenishment problem is most noticeable in the  $D\text{-max}_B - Y_B$  plot and the blue  $D\text{-min}$  density. If you think that the problem was caused by incorrect replenishment, check that the replenishment rate and setting are correct for your processor; adjust them, if necessary. Check the bleach replenishment rate regularly.

You can correct film that has been improperly bleached by rebleaching it in a known good bleach and then completing the remaining processing steps. To test for retained silver, follow the procedure given in *Appendix A*.

If you have verified that retained silver is the problem (by rebleaching or checking with an infrared scope) and it was *not caused by inadequate aeration*, add 70 mL of FLEXICOLOR RA Bleach Replenisher NR for each litre of tank solution.

Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. Repeat these additions until your control strips no longer have retained silver.

**Chart 17**



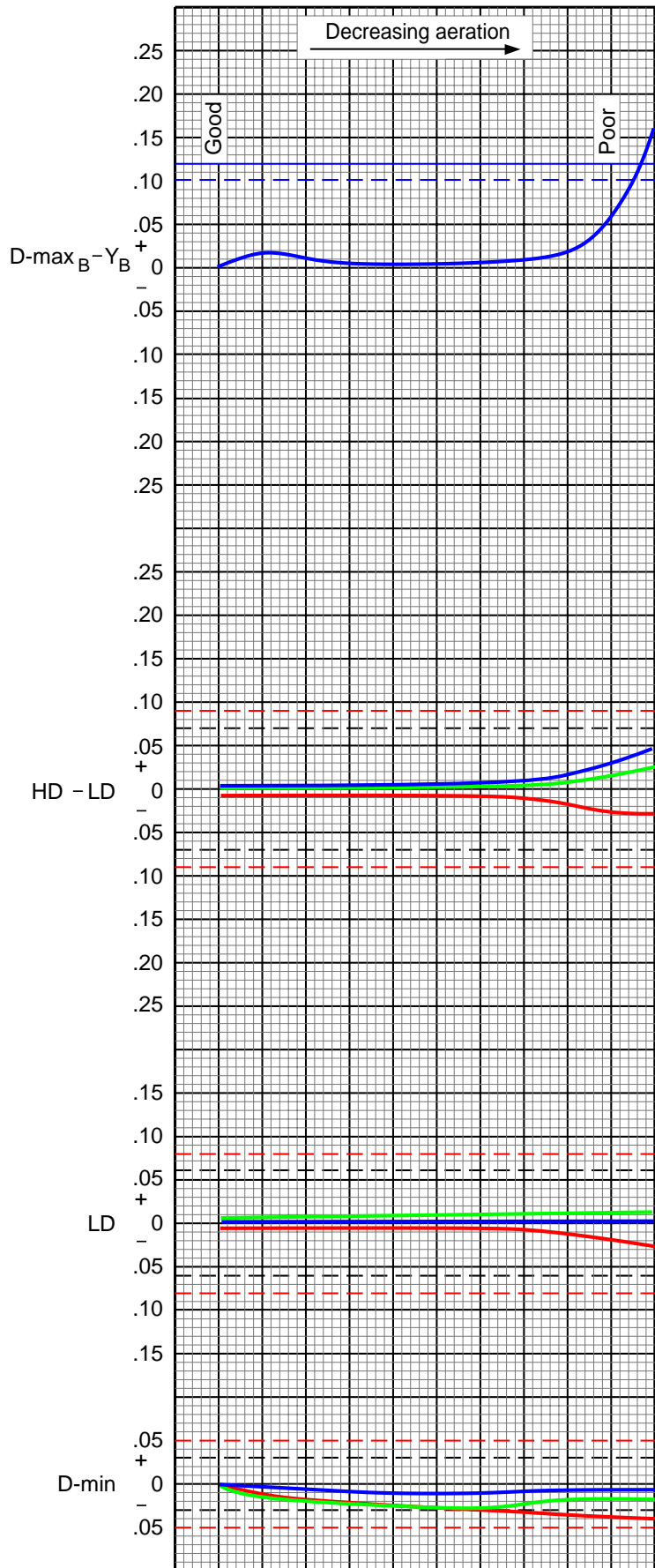
### Bleach III — Poor Aeration

Bleach activity depends on the amount of bleach aeration. Inadequate aeration causes retained silver and leuco-cyan dye.

If you determine that the problem was caused by inadequate aeration, check the air bubbling in the bleach tank. Be sure that the air supply is adequate, the tubing is clear, and the distributor tube is not clogged.

If you think that poor bleach aeration is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the  $D\text{-max}_B - Y_B$  plot, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a good bleach and then completing the remaining processing steps. See *Appendix C*.

**Chart 18**



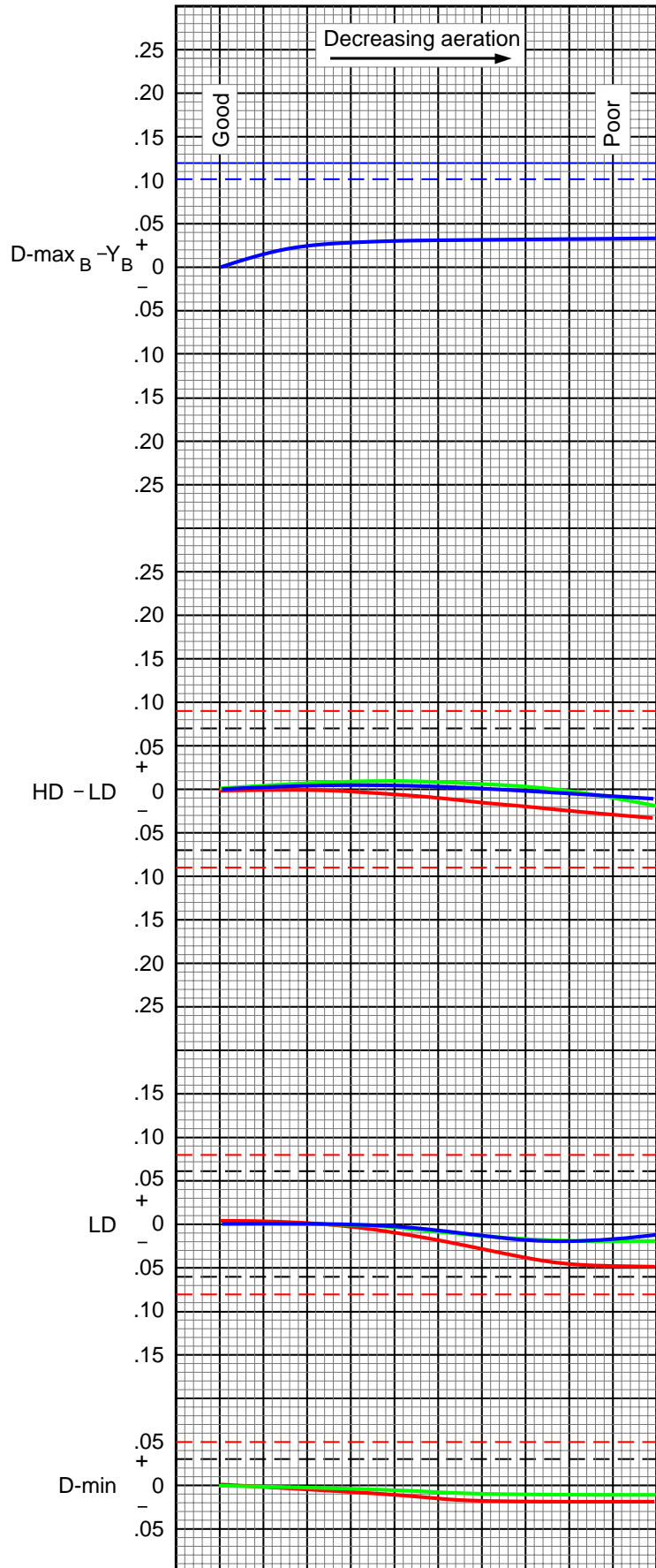
## RA Bleach— Poor Aeration

Bleach activity depends on the amount of bleach aeration. Inadequate aeration causes retained silver and leuco-cyan dye.

If you determine that the problem was caused by inadequate aeration, check the air bubbling in the bleach tank. Be sure that the air supply is adequate, the tubing is clear, and the distributor tube is not clogged.

If you think that poor bleach aeration is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the  $D\text{-max}_B - Y_B$  plot, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a good bleach and then completing the remaining processing steps. See *Appendix C*.

**Chart 19**



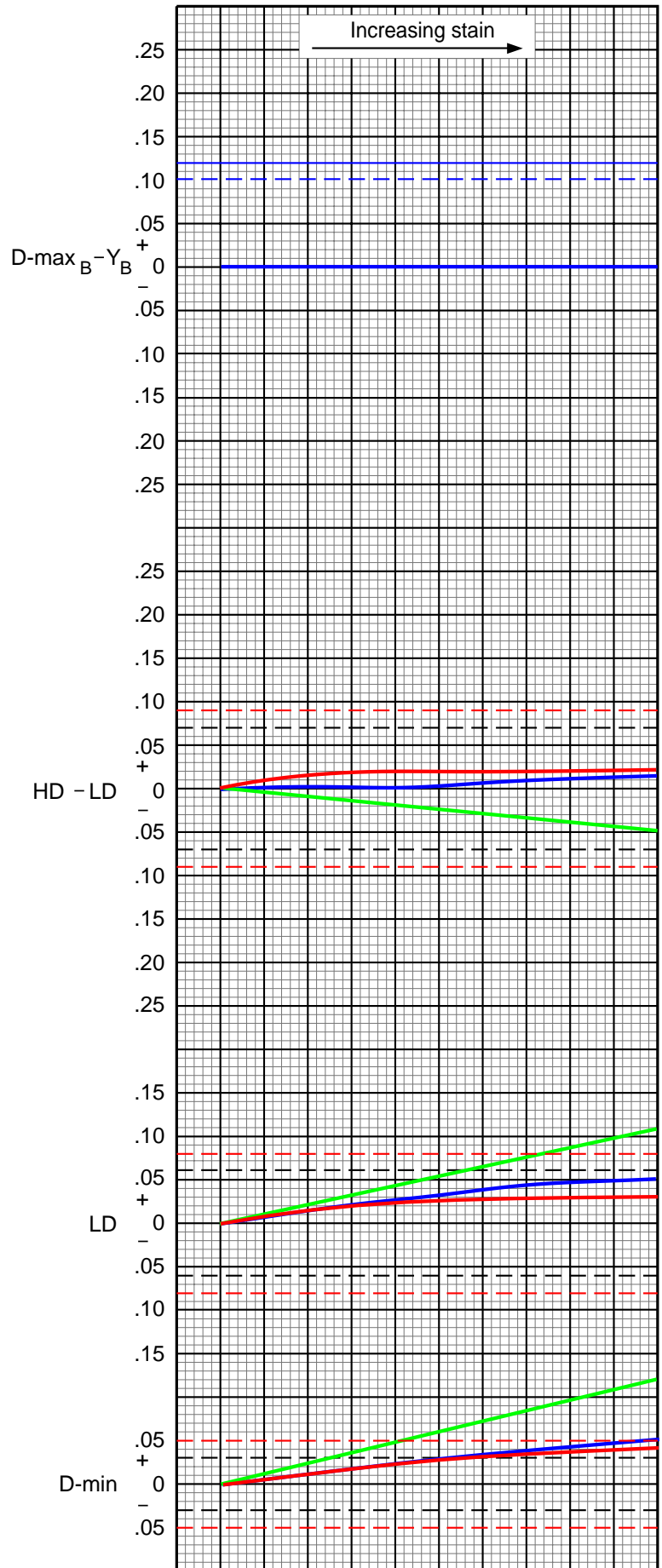
## Bleach— Stain

Under some conditions, the developing agent from developer carryover can produce a by-product that causes staining in the bleach. This by-product can be absorbed into the film, increasing the D-min and LD densities, especially in the green (magenta) layer.

The staining by-product is caused primarily by underaeration of the bleach tank solution. It can also be caused by excessive developer carryover or underreplenishment of the bleach tank solution.

To test for bleach stain, follow the procedure given in *Appendix B*. Correct the cause of the staining condition; it may be necessary to dump all or part of the bleach tank solution. If staining is minimal, an activated carbon filter in the recirculation line of the bleach may help correct the problem.

**Chart 20**





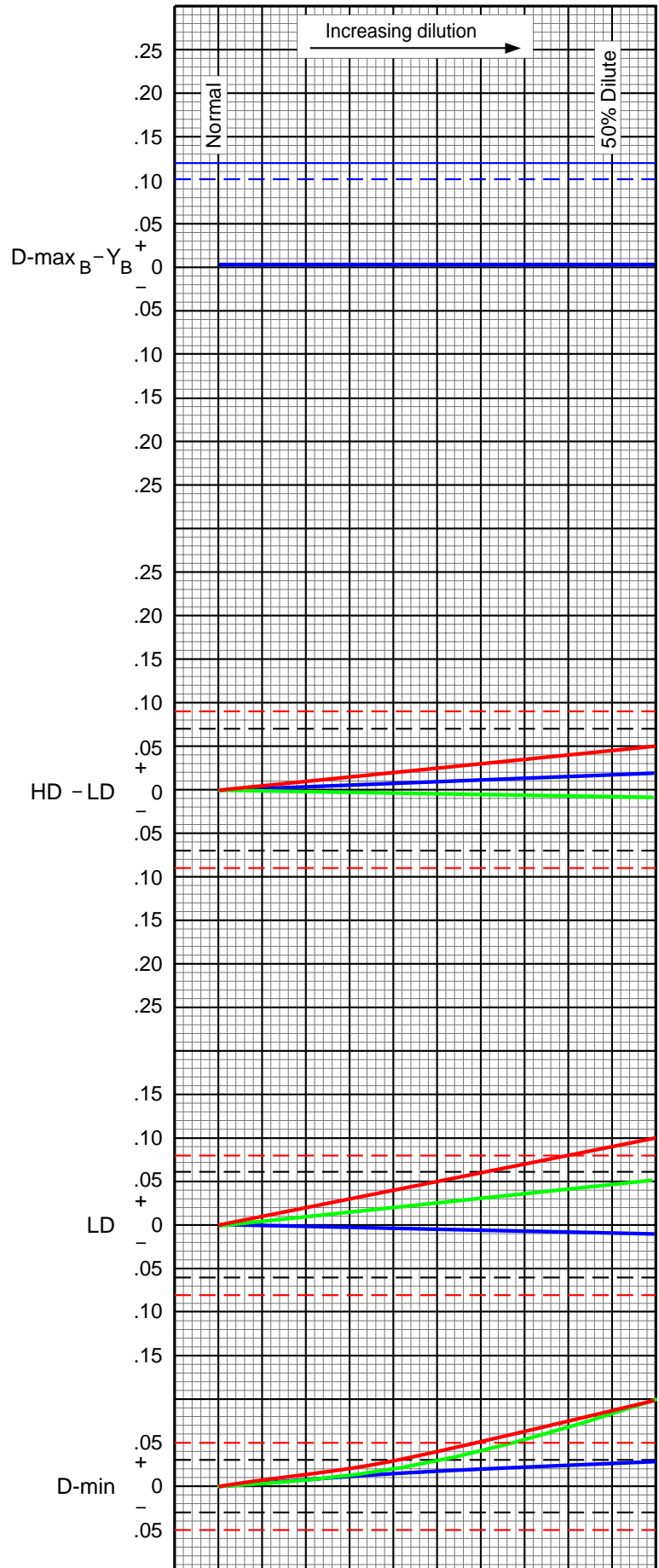
**Fixer—  
Too Dilute**

Moderate levels of fixer dilution cause increased density in the red and green D-min and LD plots. When the fixer is extremely diluted, retained silver halide and sensitizer dye cause increased density in all control plots. When that occurs, the D-min areas of the film will appear milky.

The most probable causes of insufficient fixing are fixer dilution from excessive wash carryover, too little fixer time, too much water used to prepare fixer replenisher, fixer underreplenishment, and fixer sulfurization.

If you think that diluted fixer is causing an out-of-control condition, refix and rewash your control strip according to the procedure in *Appendix D*. If refixing significantly improves the red and green D-min and LD densities, the problem was caused by the fixer. You can correct film that has been incompletely fixed by refixing and rewashing it. Be sure to eliminate the problem that causes dilution.

**Chart 21**



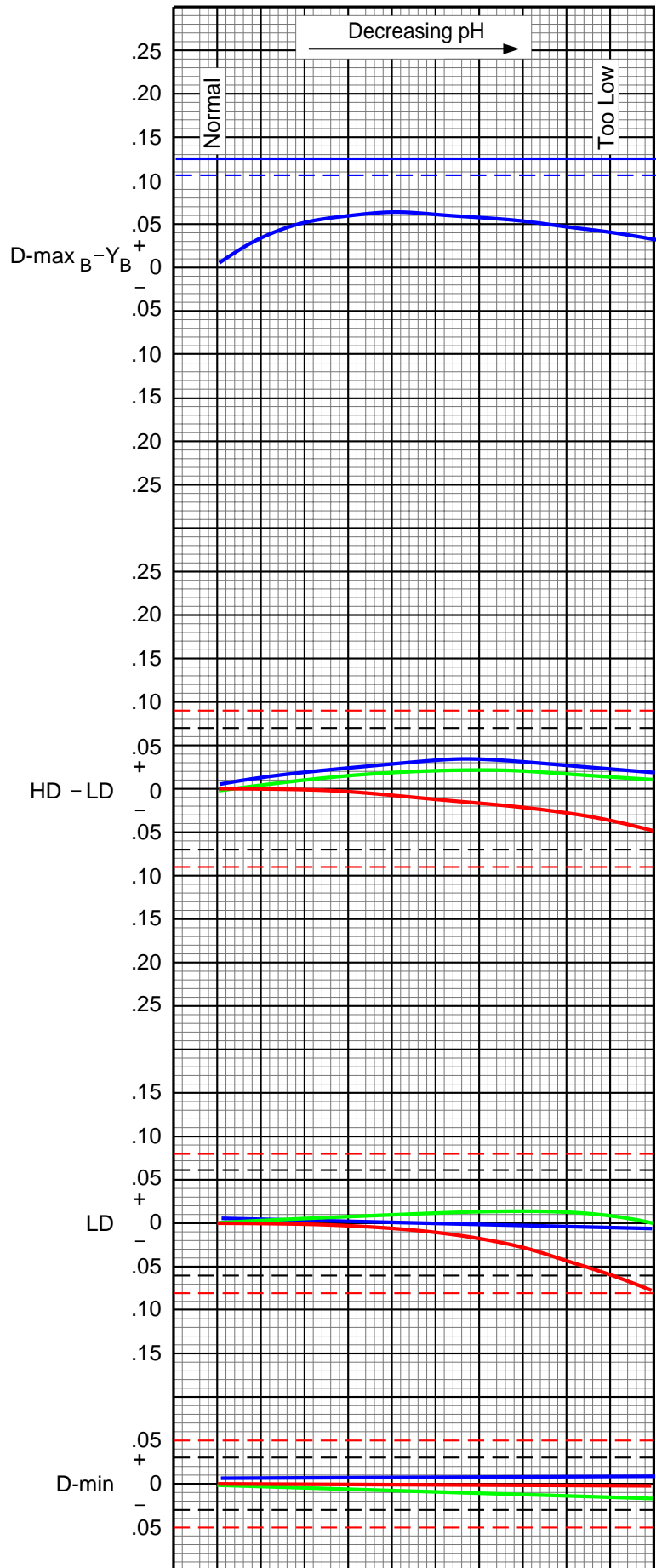
## Fixer — pH Too Low

If you desilver fixer in a closed-loop system, a malfunctioning electrolytic silver-recovery unit or incorrect pH adjustments to the fixer replenisher can lower the pH of the fixer tank solution. If the pH of the fixer is too low, it can cause a leuco-cyan dye problem.

To determine if your fixer tank solution is causing a problem, refix your control strip in the suspect fixer tank solution. See *Appendix E*. If this test confirms that the fixer is the problem, replace it with fresh fixer. Be sure to correct the cause of the problem.

You can correct film that has been improperly fixed by reprocessing it, starting with the bleach step. Use a new fixer.

### Chart 22



## APPENDIX A

### Rebleaching Test for Retained Silver

Use the procedure described below to verify retained-silver problems.

1. Zero your densitometer. Measure and record the blue densities of the D-max and yellow steps of your control strip.
2. Rebleach the control strip for 5 minutes in a *known good bleach* (i.e., a properly constituted Process C-41 bleach or a solution made from KODAK Farmer's Reducer, Part A).
3. Refix the control strip for 5 minutes in a *known good fixer* (i.e., a properly constituted Process C-41 fixer or a solution made from KODAK Farmer's Reducer, Part B).
4. Wash the control strip for several minutes and allow it to dry.
5. Rezero the densitometer. Read the blue densities of the D-max and yellow steps of the rebleached and refixed control strip.
6. Calculate the **change** in density readings of the control strip by subtracting the readings from step 1 from the readings from step 5. We will refer to these numbers as  $\Delta D\text{-max}_B$  and  $\Delta Y_B$ .
7. Subtract  $\Delta D\text{-max}_B$  from  $\Delta Y_B$  to determine the amount of retained silver. If the difference is greater than +0.08, a retained-silver problem exists. If the difference is less than +0.08, retained silver is most likely not a problem.

**Note:** You can remove retained silver from processed film by following these steps:

1. Rebleach the film in a *known good bleach*.
2. Refix the film in a *known good fixer*.
3. Run the film through the remaining process steps—wash, final rinse or stabilizer, and dry.

You can also use an infrared scope to detect retained silver.

## APPENDIX B

### Test for Bleach Stain

Use the test described below to determine if your KODAK FLEXICOLOR Bleach III tank solution is producing a stain in processed film. Use a portion of the D-min area of a KODAK Control Strip, Process C-41, that has been processed properly. The portion of the strip should be large enough for you to measure densities in two separate locations.

To test for bleach stain, follow these steps:

1. Cut a section of D-min from the width of a control strip that is approximately 13 mm ( $\frac{1}{2}$  in.). The D-min densities should plot in control on your control chart. If you do not have a strip that provides in-control readings for D-min, use a portion of the D-min area of the reference strip.
2. Remove a sample of the bleach tank solution, and place it in a small container (e.g., fill a 100 mL graduate to the 75 mL mark with bleach). Start the test when the solution has cooled to room temperature.
3. Insert half of the piece of D-min into the bleach sample. Leave it in the solution for 20 minutes at room temperature with no agitation.
4. Immerse the entire D-min film sample in a still-water bath at room temperature for 20 seconds.
5. Allow the film to dry. Read the densities of both halves of the film sample. Compare the density readings. A difference of more than 0.12 density units in any color indicates staining from the bleach.

If staining is minimal, an activated carbon filter in the recirculation line of the bleach may help correct the problem. If staining is more severe, replace one third to all of the bleach tank solution. If the tank solution is a regenerated bleach, replace one third to all of the tank solution, overflow, and replenisher solution in your bleach system.

## APPENDIX C

### Test for Proper Bleach Aeration

Use KODAK Aeration Test Solution to determine if a bleach is sufficiently aerated to be effective. Use the test described below with KODAK FLEXICOLOR Bleach III tank solution.

#### Materials Needed

- KODAK Aeration Test Solution, CAT No. 129 2069
- Eyedropper or pipet
- Vessel for removing a bleach sample
- 10 mL clear glass graduated cylinder or test tube

#### Procedure

1. Thoroughly stir the bleach solution that you are testing, and remove a small sample.
2. With an eyedropper or pipet, remove a small amount of the sample, and place one drop of it in the graduated cylinder.
3. Add 5 mL of KODAK Aeration Test Solution to the bleach sample in the graduated cylinder.
4. Swirl the contents of the cylinder until the two solutions are well mixed.
5. **Within 5 minutes of mixing the solutions**, note the color of the mixed solution in the graduated cylinder, and then analyze the results according to Table 5-5.

Table 5-5

Solution Color	Condition
Blue	Properly aerated
Green	Adequately aerated
Brown	Not enough aeration

**Note:** This test assumes that the bleach solution being tested is at normal concentration; an under- or overconcentrated solution can produce inaccurate test results.

## APPENDIX D

### Test for Retained Silver Halide

Use this test to determine if processed film has retained silver halide.

1. Zero your densitometer. Read and record the red Status M density of the D-min step of a control strip that you have processed recently.
2. Refix the control strip for 5 minutes in a *known good fixer* or a solution made from KODAK Farmer's Reducer, Part B.
3. Wash the control strip for 2 to 3 minutes, and allow it to dry.
4. Rezero your densitometer. Read and record the red density of the D-min step of the refixed control strip.
5. Calculate the **change** in density readings by subtracting the reading from step 4 from the reading from step 1.

Any significant change in density readings after refixing indicates a fixer problem. If a *loss* in red density is greater than 0.05 for D-min or LD, a retained silver-halide problem probably exists due to low activity of the fixer tank solution. This problem may be accompanied by retained sensitizing dye. If the *loss* in red density is less than 0.04, the activity of the fixer tank solution is probably acceptable.

## APPENDIX E

### Rebleaching Test for Leuco-Cyan Dye

If the pH of a fixer tank solution is too low, leuco-cyan dye may form. To test for leuco-cyan dye formed in the fixer, follow this procedure:

1. Zero your densitometer. Measure and record the red LD density of a recently processed control strip.
2. Rebleach the control strip for 5 minutes in a *known good bleach* (i.e., a properly constituted Process C-41 bleach or a solution made from KODAK Farmer's Reducer, Part A).
3. Wash the control strip for several minutes and allow it to dry.
4. Rezero your densitometer. Read the red LD density that you measured in step 1.
5. Calculate the **change** in density readings by subtracting the reading from step 1 from the reading from step 4. If the difference is greater than +0.08, a leuco-cyan dye problem exists. If the difference is greater than +0.05, a marginal leuco-cyan dye problem may exist.
6. If the fixer is the source of the problem, dump the fixer tank solution and replace it with fresh solution. For a closed-loop system, you may add sodium hydroxide or ammonium hydroxide to the fixer to adjust the pH to  $6.5 \pm 0.5$  (check the pH with a pH meter). Also, check for fixer underreplenishment, a current that is excessive for in-line electrolytic desilvering, or excessive carryover into the fixer.

**Note:** You can convert leuco-cyan dye that formed in the fixer to normal cyan dye by following these steps:

1. Rebleach the film in a *known good bleach*.
2. Refix the film in a *known good fixer*.
3. Run the film through the remaining process steps—wash, final rinse or stabilizer, and dry.

