4 TROUBLESHOOTING PROCESSES C-41 AND RA-4

This section describes the following:

- How to recognize common control-chart plotting patterns
- How to troubleshoot your process using the Visual Process Control Guides for Process C-41 and Process RA-4
- What corrective action to take to eliminate the source of your process control problem

The Visual Process Control Guides in this section are a one-page representation of how all common process control problems will plot on your control-chart. The red, green, and blue arrows on the guides correspond to the red, green and blue lines plotted on your control-chart, and the direction they will plot when problems are indicated. Once you familiarize yourself with the contents of this section, you will find it easy to recognize process problems and what action to take to correct these problems.

Control-Chart Patterns

Once you have the control strip data plotted over time, it is important to recognize common control-chart patterns. How the control strip plots from day to day (history) can help you to determine the source of a problem. The history of a control chart-pattern can generally be separated into three categories: a trend, a sudden change (spike), or cycling.

Trend—When the control plot deviations change slowly from day to day in one direction (high or low), this is a trend. A control-chart pattern which is a trend usually indicates a chemical problem in one or more of your tank solutions. Trends are most often caused by:

- improper replenishment due to high or low replenishment rate
- incorrect mixing of replenisher
- evaporation or oxidation of tank solutions due to the processor operating in low utilization conditions

Sudden Change/Spike—A sudden change or spike occurs when the plot deviations change suddenly from one day to the next, or from one processed control strip to the next strip processed. This control-chart pattern could indicate both physical or chemical problems with the process, such as the following:

- a physical problem with the processor, such as tank solution temperatures or times that are too high or low
- a physical problem with the process such as an agitation pump not working properly
- incorrect densitometer readings due to a bad reading or a densitometer that is not calibrated
- contamination of developer due to bleach, fix or bleach-fix getting into the developer tank

Cycling—When the plot deviations constantly go from a high position to a low position (or vice versa) from day to day, or from strip to strip, this is known as cycling. A control control-chart pattern that cycles usually indicates a physical problem with the processor or densitometer, such as the following:

- a physical problem with the processor, such as tank solution temperatures that are too high or low or transport speed that is too fast or slow.
- inaccurate densitometer readings due to a densitometer that is not calibrated or inconsistent due to a bad lamp or other problems.

TROUBLESHOOTING YOUR PROCESS

When the controls strip deviations on the control chart exceed an action limit, or indicate an out-of-control condition, follow these steps to troubleshoot the problem:

1. First check for set-up or operational errors
   - Make sure control strip code matches the reference strip code
   - Calibrate densitometer
   - Re-check control strip aims and verify correction factors
   - Verify the problem by processing a second control strip
   - Determine if any recent processor maintenance could have potentially resulted in a problem
   - Verify that previous tank or replenisher solutions were mixed correctly
   - Verify that the developer temperature, and other solution temperatures, are correct with a separate thermometer
2. Compare the plot deviations on your control-chart to the "Visual Process Control Guide" to pinpoint possible sources of the problem.
   - Compare the plot deviations for each control parameter on your control chart to the corresponding control parameter of the Visual Process Control Guide. Compare each control parameter separately; BP, D-max$_b$-Y$_b$, HD-LD, LD, D-min.
   - For plotted deviations that meet or exceed the action or control limit, match the pattern of the red, green and blue plot deviations to the visual representations on the Visual Process Control Guide. Pick the best-fit pattern, then record all the possible problems those plot deviations indicate.
   - Review the history of the plot deviations on your control-chart and determine whether the plots indicate a trend, and sudden change/spike, or a cycling pattern. Based upon this plot history, prioritize the possible problems you recorded, listing the most likely potential problems first and the least likely last.
3. Refer to corrective action section for resolution
   - Consider each potential cause on your prioritized list of potential problems, and check the corresponding operating conditions of the processor.
   - Do any testing required to verify problem as suggested in the Corrective Action and Prescriptions section.
   - Apply prescription as suggested in the Corrective Action and Prescriptions section to bring process with in control.
   - **Most importantly**, address root cause of the problem for final resolution, so it does not return.

Process C-41
Visual Process Control Guide

D-max$_B$-Y$_B$
(+ 0.10 & 0.12)
Bleach Activity
- retained silver

HD-LD
(+/- 0.08 & 0.10)
Developer Activity
- concentration
- contamination
- oxidation/low utilization
- agitation
- mix errors

LD
(+/- 0.08 & 0.10)
Developer Activity
- time/temp
- replenishment

D-min
(+ 0.05 & 0.07)
Developer,
- overconcentration
- overreplenishment

Bleach,
- stain

Fixer Activity
- retained silver halide

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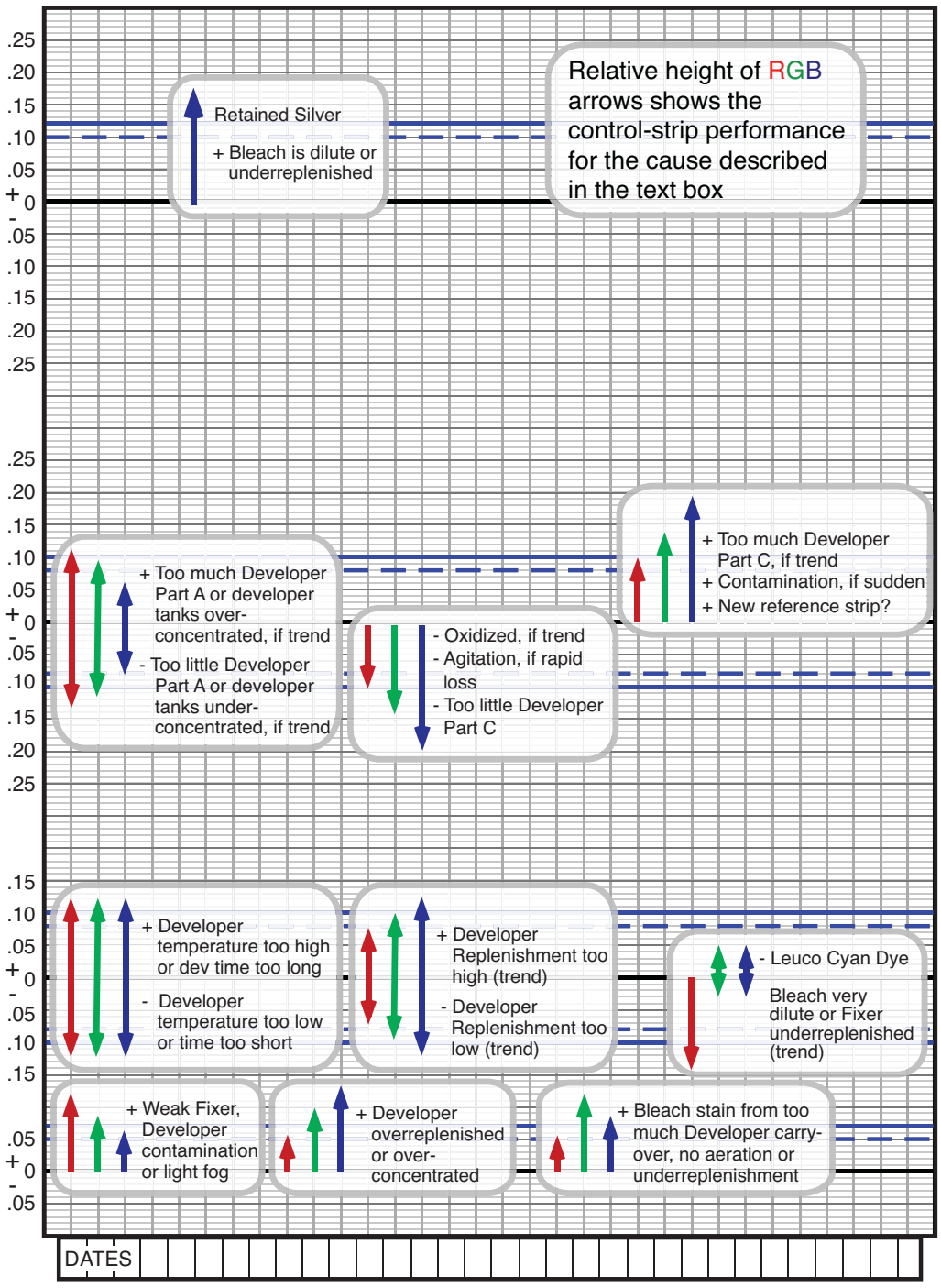

PROCESS: _____

MACHINE: _____

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PROCESS C-41 CORRECTIVE ACTION AND PRESCRIPTIONS

Use these corrective actions and prescriptions for Process C-41.

D-max$_b$—Y$_b$

This parameter monitors the performance of the bleach solution for **retained silver**. A bleach solution that is underreplenished or diluted will not efficiently bleach the film, leaving retained silver in higher-density areas. If the D-max$_b$-Y$_b$ indicates a retained-silver problem, confirm it with the following test.

1. Immerse the processed control strip that plotted high in D-max$_b$-Y$_b$ in bleach replenisher concentrate, and soak the strip for 5 minutes; agitate intermittently.
2. Remove the strip, rinse it thoroughly with water for 5 minutes, and allow it to dry.
3. Reread the strip, and re-plot D-max$_b$-Y$_b$.
4. Compare the new plot to the original plot. A difference of 0.08 density units or more confirms a bleaching problem. If there is no difference or a change of less than 0.08, the bleach is not a problem. See the "Process C-41 Visual Process Control Guide" for other possible causes.

Prescription

- For C-41RA and C-41B Processors: If the plot is 0.25 density units over aim or less, add bleach replenisher concentrate directly to the working tank in an amount equal to 70 mL per litre of bleach tank solution. If plots are over 0.25 density units high, replace all the tank with freshly mixed bleach tank solution.

HD - LD (Contrast)

HD-LD monitors developer activity. Contrast is a primary indicator of problems with **developer agitation**, **oxidation**, **concentration**, or **contamination**. If the developer tank solution is under-agitated, diluted, or oxidized, the plots will be low. If it is overconcentrated or contaminated, the plots will be high.

You must dump and replace the developer tank solution in these situations:

- Plots are more than 0.16 density unit over or under aim.
- The developer is contaminated
- The developer is too dilute (underconcentrated)
- A mix error in the developer replenisher causes out-of-control plots.

If the plots are less than 0.16 density unit over or under aim, you can try a prescription.

Prescription

- For **high HD-LD** plots:

  Overconcentration: Dilute the developer tank solution with an amount of warm water equal to 5 percent of the developer tank volume. Repeat as necessary until the process is in control.

- For **low HD-LD** plots:

  Under-agitation: Replace the agitation pump on the processor.

  Oxidation: If air bubbles are visible in the developer tank, look for a small air leak or loose fitting. If oxidation is caused by low utilization, see KODAK Publication No. CIS-246, "Operating Minilabs in Periods of Low Production Volumes." Replace the developer tank with a fresh working tank solution.

LD (Speed)

LD monitors developer activity. Speed is a primary indicator of problems with **developer time, temperature, and especially replenishment rate**. A long developer time, a temperature that's too high, or overreplenishment , will cause high LD plots. A short developer time, a low temperature, or underreplenishment, will cause low LD plots.

Check developer time and temperature, and adjust them to specifications. Developer time should be 3:15 ± 5 seconds; temperature should be 37.8 ± 0.15°C (100 ± 0.25°F).

If the plots are more than 0.16 density unit over or under aim, dump and replace the developer. If the plots are less than 0.16 density unit over or under, you can try a prescription.

Prescriptions

- For **high LD** plots:

  Overreplenishment: Make a solution of 1 part FLEXICOLOR Developer Starter LORR to 4 parts water. Add the mixture to the developer tank at a rate of 50 mL per litre of tank solution. Repeat additions until the process is in control.

- For **low LD** plots:

  Underreplenishment: Add 50 mL of mixed FLEXICOLOR Developer Replenisher LORR per litre of tank solution to the developer tank. Repeat additions until the process is in control.

D-min (Clear Area of Strip)

D-min monitors developer, bleach, or fixer problems. If the D-min indicates a developer problem, see either "HD-LD (Contrast)" or "LD (Speed)" for confirmation and corrective action. If the D-min indicates a bleach or fixer problem, see the corrective action below:

Fixer (Retained Silver Halide)—Retained silver halide is caused by an exhausted fixer solution due to underreplenishment, dilution, or oxidation. D-min will show retained silver halide with high plots, especially the Red D-min. To confirm retained silver halide, run this test:

1. Immerse the processed control strip that plotted high in D-min in mixed fixer replenisher, and soak it for 5 minutes; agitate intermittently.
2. Remove the strip, wash in running water for 5 minutes, and allow it to dry.
3. Reread the strip and replot the D-min density readings.
4. Compare the Red D-min to the original plot. A change of at least 0.05 density unit confirms a fixer problem. Replace the fixer tank solutions with freshly mixed fixer replenisher solution. If there is no change or a change of less than 0.05, the fixer is not a problem. See the "Process C-41 Visual Process Control Guide" for other possible causes.