

3 PROCESS MONITORING

Process monitoring is the routine gathering and recording of information on all aspects of your photographic process to manage the quality of the finished order production in your lab. It involves the collecting and recording of data, which measures the performance of your photographic processes. One example of quality control that all labs practice is the checking of the color and density of finished customer print orders. This type of quality control is a subjective measure, since there is some judgment in determining what is acceptable quality in a print. However, checking the quality of print orders is a reflection on the quality of your entire photographic system, i.e., the characteristics and performance of the film, your film processor, your paper processor, and the adjustment of the printer. When problems do occur, checking the quality of finished customer orders is not sufficient for diagnosing the cause of a problem and where it is occurring. To better determine the cause of any photographic problem within your lab we like to use objective measurements that require no judgment, and are more specific in pinpointing the potential sources of the problem. Examples of objective measurements are:

- Temperatures of your processing tank solutions
- Replenishment rates of your tank solutions
- Plotted deviations from your KODAK Control Strips for Process C-41 and Process RA-4

Processing KODAK Control Strips and plotting the densitometric data over time is one of the best methods of determining the cause and source of quality problems within the lab. Often, data from the processed control strips can indicate potential problems before they become evident in your lab's finished order production. This provides your lab with an approach to process monitoring that is proactive in managing your quality.

PROCESS-MONITORING TERMS

The following terms are frequently used in process monitoring:

Action Limits—The action limits are the boundaries of the desired operating range of the process. As long as the 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 safely 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 (i.e., the “aim zone”), your process is in control.

Aim Values—These are the values to which you compare your control-strip densities. To obtain aim values, read the reference-strip densities; then apply the correction factors to the density readings. Enter these 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 the 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 from your process control strip plots beyond the control limit, the process is out of control. This may result in unsatisfactory color, density, and/or contrast in your lab's production. When any density value plots beyond the control limits, 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 of control strips. Correction factors usually differ for each code number.

Reference Strip—This is a control strip that is precisely exposed and processed by Kodak at 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— Tolerances and limits are density variations allowed before you **must** take corrective action; they include an aim-value adjustment tolerance, and action and control limits.

Tolerances and Limits for KODAK Control Strips, Process C-41

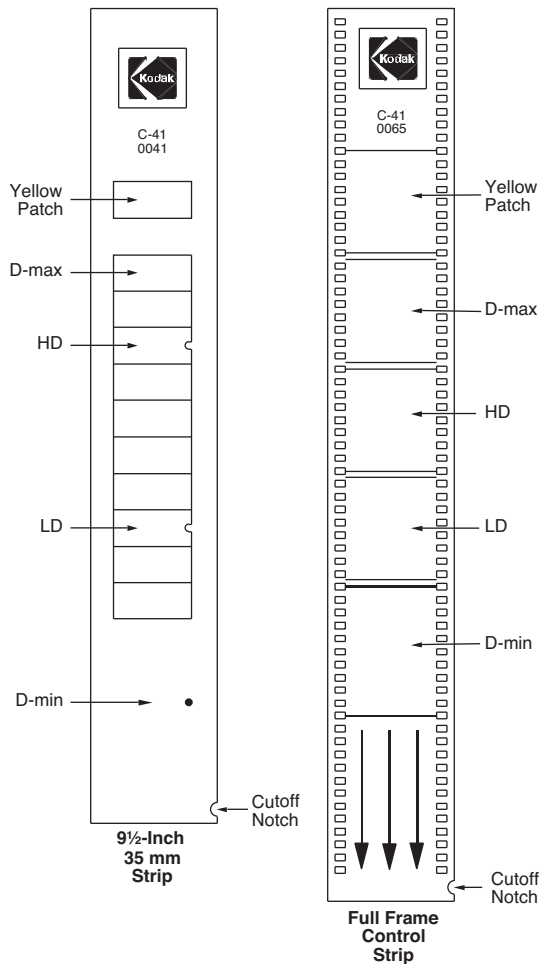
Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits	Color Balance Spread Limit
D-min	+ 0.03	+ 0.05	+ 0.07	NA
LD	±0.04	±0.08	±0.10	NA
HD - LD	±0.03	±0.08	±0.10	0.09
D-max _B - Y _B	±0.07	+ 0.10	+ 0.12	NA

NA = Not Applicable

Tolerances and Limits for KODAK Control Strips, Process RA-4

Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits
D-min	—	—	+ 0.02
LD	±0.04	±0.10	±0.12
HD - LD	±0.03	±0.10	±0.12
BP	±0.05	- 0.10	- 0.15

Figure 3-1: KODAK Control Strips, Process C-41



Using Control Strips to Monitor Your Process

To begin process monitoring, you will need—

- KODAK Control Strips, Process C-41
- KODAK Control Strips, Process RA-4
- A precision densitometer equipped with Status M (or equivalent) filters to read the film-process control strips and Status A (or equivalent) filters to read the paper-process control strips
- KODAK Process Record Form Y-55 or similar graph paper
- Red, green, and blue pencils, markers or pens

You can also use a computer program such as KODALINK Service to plot your process.

CONTROL STRIPS

KODAK Control Strips: The Basic Control Material

KODAK Control Strips are available for monitoring your processes. For a film process that uses KODAK FLEXICOLOR Chemicals, use KODAK Control Strips, Process C-41. For a paper process that uses KODAK EKTACOLOR Chemicals, use KODAK Control Strips, Process RA-4. A pre-processed reference strip is packaged with each type of control strip. Each control strip, reference strip, and box label is marked with a code number. The code number identifies the strips as part of a specific batch. Each box contains correction factors for that particular code number. Use these correction factors to calculate the aim values for this batch of strips.

KODAK Control Strips, Process C-41 (35 mm)—These control strips are exposed on 35mm KODAK GOLD Film and come in two configurations:

- **KODAK Control Strips, Process C-41, 35 mm x 100 ft roll**—These strips are available in a 100-ft roll and contain approximately 120 strips, with cutoff notches at 24 cm (9.5-inch) intervals. The roll is wound emulsion side in, with the D-min step oriented toward the outer end of the roll. Each strip has 12 steps: a yellow step, a D-max step, and 10 equal increment density steps. The LD and HD steps are identified by a "U" indent mark on the side of the density step. Measure the areas adjacent to the black dot to obtain the D-min reading. These strips are typically used for any continuous, roller transport, or minilab type processor.

- KODAK Full Frame Control Strips, Process C-41—**
 These strips are available in a 50-ft roll containing approximately 40 strips, with cutoff notches every 38.1 cm (15-inch) intervals. The roll is wound emulsion side in, with the D-min step oriented toward the outer end of the roll. Each strip has 5 full frame steps: a yellow step, a D-max step, an HD step, a LD step, and a D-min step. This format of control strip is used with minilab printers that have a scanner capable of reading a large area transmission density. This eliminates the need for a separate densitometer.

KODAK Control Strips, Process RA-4—Use these strips to monitor your paper process. They are available in boxes of 25 strips. The strips are packaged in moisture-resistant, light tight envelopes that contain five strips each. Each control strip, reference strip, and box label is marked with a code number. The code number identifies the strips as part of a specific batch. Each reference strip envelope contains correction factors for that particular code number. Use these correction factors to calculate the aim values for this batch of strips.

Each strip measures 8.9 x 30.5 cm (3 1/2 x 12 inches), and contains three neutral patches, a yellow patch, and an unexposed area. Measure the neutral patches to obtain density values for LD (low density), HD (high density), and BP (black patch). Measure the unexposed patch to obtain the density value for D-min. Use the yellow patch as a visual indicator of retained silver caused by low bleach-fix activity. When retained silver is present, the yellow patch will appear brown and less saturated than normal.

For information on other types of control strips, see Kodak Publication Z-99M, *Introduction to Color Process Monitoring for Minilabs*, available online at www.kodak.com/go/photochemicals.

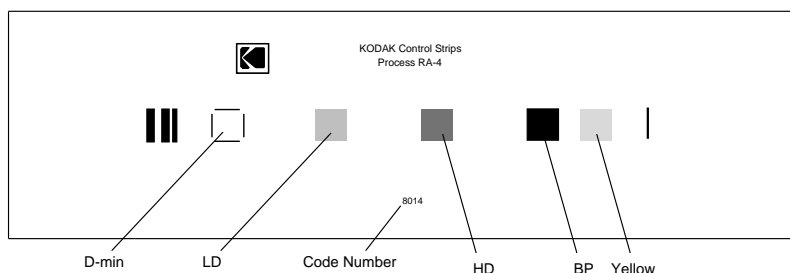
STORING, HANDLING, AND PROCESSING CONTROL STRIPS

Storing and Handling Control Strips

Store unused KODAK Control Strips, Process C-41, at a temperature of 4 to 13°C (40 to 55°F) (refrigerate, do not freeze). Store unused KODAK Control Strips, Process RA-4, at -18°C (0°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 storage.

Handle control strips by the edges to prevent fingerprints and surface damage, and allow sufficient time (approximately 15 minutes) for the control strips to warm up to room temperature before you process them.

Store the reference strip in its envelope when you are not using it.



F002_0818BC

Processing Control Strips

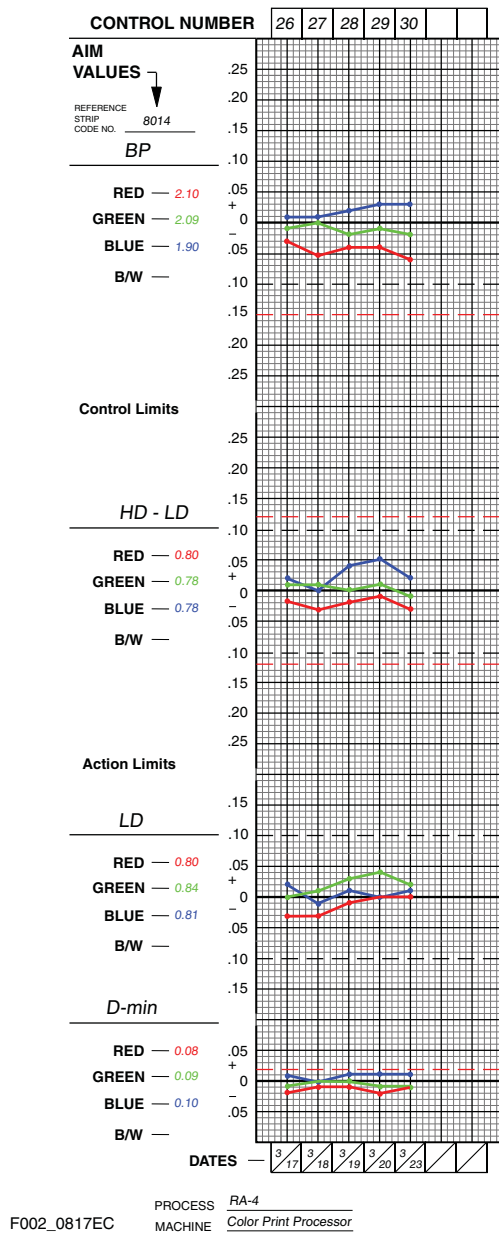
Each time you process a control strip, position it in the same location in your processor. Process a control strip—

- at the beginning of the day or shift, before processing customer work
- at regular intervals with customer work, if necessary
- at the end of the day or shift, if necessary

Record the calculated plot deviations on a control chart, or you can use an internet-based process monitoring service such as KODALINK Service.

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 example shown.



1. On Form Y-55 record in the action and control limits given in the appropriate table found in *Tolerances and Limits*. 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 reference strip to warm, moist air can cause low readings, particularly in the higher density patches. (If this occurs, wash the reference strip in warm water and repeat the density readings.)
3. Use a precision densitometer to measure the densities in the center of each of the patches on the reference strip. **Do not** move the strip as you make the density readings or you may affect the precision and repeatability of the measurements.

For the film process, measure the following densities of the reference strip. Set your densitometer to the transmission mode, and use the Status M filters.

Measurement	Step	Filter
HD	notched step closest to D-max	red, green, blue
LD	notched step closest to D-min	red, green, blue
D-min	clear area next to a black dot	red, green, blue
Y _B	yellow patch	blue
D-max _B	maximum density patch	blue

For the paper process, measure the following densities of the reference strip. Set your densitometer to the reflection mode, and use the Status A filters.

Measurement	Step	Filter
D-min	unexposed patch	red, green, blue
LD	low density	red, green, blue
HD	high density	red, green, blue
BP	black	red, green, blue

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.

Using KODAK Chemicals in Minilabs

4. To calculate aim values, apply the correction factors supplied in the instruction sheet packaged with each box of control strips to the reference-strip densities. 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 values from the adjusted HD values.
 - To obtain the $D\text{-max}_B - Y_B$ aim value, subtract the adjusted blue density of the yellow step from the adjusted blue density of the D-max step.
5. Process a control strip and measure the same patches that you measured in step 3. Use a precision densitometer to measure the densities in the center of each of the patches on the reference strip. Do not move the strip as you make the density readings or you may affect the precision and repeatability of the measurements.
6. Calculate the deviations 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 deviations from aim plots beyond the action or control limits, process another control strip. If the second strip confirms the results of the first strip, determine the cause of the problem.
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.

Kodak, Kodak Professional, Edge, Ektacolor, Flexicolor, Gold, Prime, Relay, Royal, and Supra are trademarks.

Revised 7-11

Using KODAK Chemicals in Minilabs
KODAK Publication No. Z-100-3