Introduction to Color Process Monitoring For Minilabs

KODAK Publication No. Z-99M

Contents

Introduction to Color Process Monitoring

This publication provides a step-by-step approach to the principles of color process monitoring. We'll begin with the basics and then lead you to information about specific processes and products.

Process monitoring is a means of consistently obtaining the best photographic quality with the minimum of waste and cost. In the following pages, you'll learn—

- Why you should monitor your process
- How a color process works
- What is a well-controlled process
- What causes process changes
- What equipment and materials you'll need
- How to monitor a process
- What to do about an out-of-control process
- What control procedures are available
- What control products are available

WHY SHOULD YOU MONITOR YOUR PROCESS?

Consistent, high quality is good business. It means satisfied customers because they receive good results, which in turn means new and repeat business. High-quality photographic processing depends on meeting and maintaining process and product standards. You can meet and maintain these standards by following the manufacturer's processing and printing recommendations, and by monitoring and controlling your process.

Process monitoring enables you to ensure that your process is operating consistently within tolerances that yield high-quality negatives or prints. When you control your process carefully and your process stays in control, you'll reduce waste, avoid downtime, and increase customer satisfaction, employee productivity, and profits.

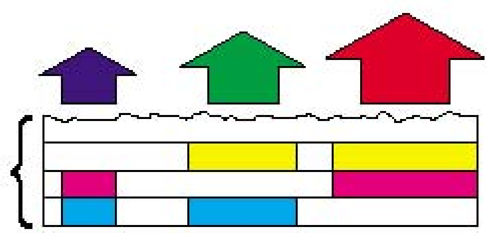
Process control provides the following benefits:

- Process consistency
- Higher overall quality of processed film or prints
- Greater total yield of acceptable film or processing capacity
- Early detection of process and/or equipment problems
- Less waste of time, chemicals, film, and paper
- Increased printing productivity
- Greater customer satisfaction

HOW DOES A COLOR PROCESS WORK?

White light is composed of varying amounts of red, green, and blue light. Color films and papers are able to record all the colors of a scene because they have separate emulsion layers that are sensitive to the colors that make up white light. A minimum of three layers is required: one sensitive to blue light, one sensitive to green light, and one sensitive to red light. Other emulsion and filter layers may be required depending on the film or paper type.

Most color films and papers have dye-forming chemicals incorporated in the emulsion. Chemical reactions during development determine the color formed in the individual layers. All conventional color processes require steps for development, bleaching, and fixing.



Other processing steps remove chemicals and chemical by-products that are not used in forming the image. These by-products are usually removed in the bleach, fixer, wash, final rinse, and stabilizer steps.

Here are the basic steps in the most commonly used color film and paper processes:

1. The developer acts on the silver-halide latent image to produce a silver image.
2. Dye is formed in the silver image area when development by-products react with the color couplers in the emulsion.
3. After the dye image is formed, the silver image is bleached to convert the developed silver to a soluble silver salt that can be removed.
4. During fixing, all the silver is removed, leaving only a dye image.

Color Negative Process

- Develop silver image and form dye
- Oxidize silver
- Remove silver

The solutions and steps for the most common color processes are listed below.

Color Negative Film	Color Prints from Color Negatives
Process C-41	*Process RA-4*
Developer	Developer
Bleach	Bleach-Fix
Wash	Stabilizer or Wash
Fixer	Dry
Wash	
Final Rinse	
Dry	

For more information on the individual steps in a particular process cycle, see the KODAK Publications listed on page 9.

WHAT IS A WELL-CONTROLLED PROCESS?

A well-controlled process is one that consistently produces high-quality results with minimum waste. High-quality results are consistent with those that the film, paper, and printer were designed to produce and are satisfying to the customer. A good quality finished print or transparency will be of the proper density and color balance, with matched contrast in all three-color layers, dense, detailed shadow areas and clean whites.

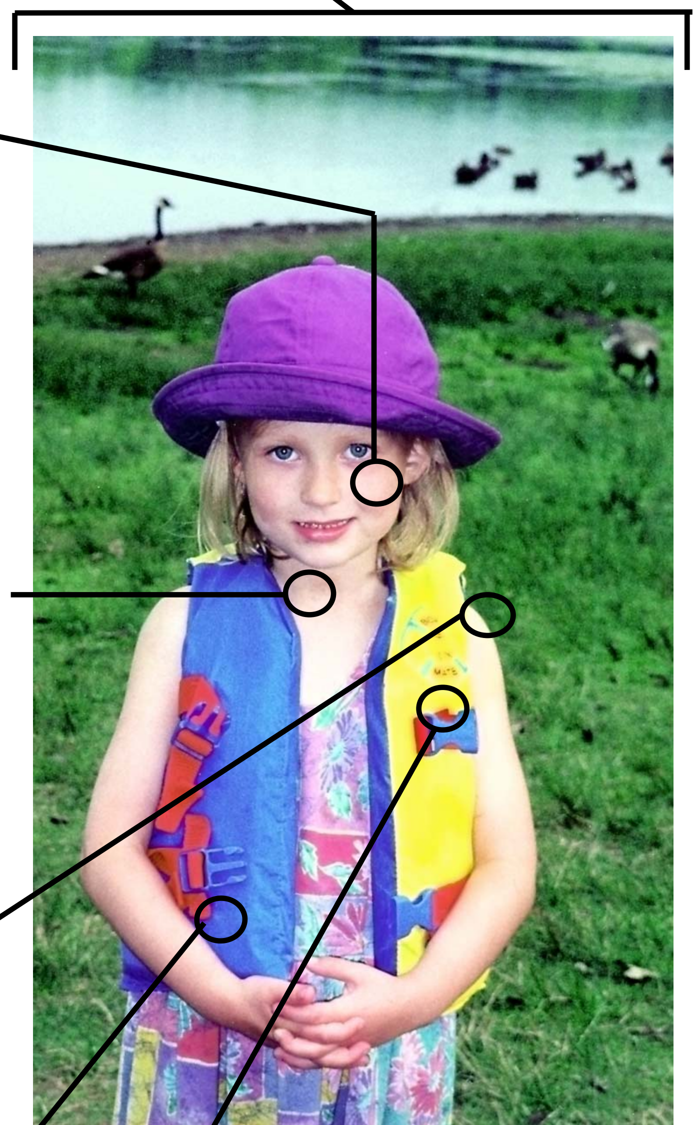
To be sure of high-quality results, you must keep your printing and processing operations within specifications during your production schedule. When you monitor the process with control strips as described on page12, a well controlled process will consistently plot within the established control limits.

What Are The Attributes Of A Good-Quality Finished Photograph?

A well-exposed and processed print will have these attributes:

1. **Density—**Normally lighted areas of the original scene reproduce to an appropriate density level in the finished photograph. Density is determined by camera exposure, development conditions, and printer exposure (in prints).
2. **Color Balance—**Neutral grays and flesh tones are the most sensitive, and therefore the most critical areas of a photograph to the viewer. If it is well balanced, neutral grays reproduce without any color bias; flesh tones appear natural. Color balance is generally determined by the quality of the original light source, development, and printer color balance.
3. **Contrast—**The contrast in each of the three-color layers should match. Otherwise, it will be impossible to obtain good color balance over the entire exposure range. For example, with a color negative film, if the contrast of the green-sensitive emulsion layer is lower than that of the red and blue layers, high-density areas in prints—such as hair and shadows—will be green in the final print even though mid scale densities, such as flesh tones, are properly balanced. Mismatched contrasts can result from poor film keeping, contamination or mixing errors in any of the processing solutions, over- or underdevelopment, and inadequate bleaching or fixing.

   Also, the overall contrast must not be too high or low. A print that is too low in contrast will appear "muddy" or flat because the range of densities between the highlight and shadow areas is too small. Low contrast is usually the result of underexposure or underdevelopment. A print that is too high in contrast will appear harsh because the range of densities between the highlight and shadow areas is too great. The highlight areas often lack detail and appear "washed out"; the shadow areas often lack detail and appear "blocked up." High contrast is usually the result of overexposure or overdevelopment.
4. **Highlight Areas and Minimum Density (D-min)—** Whites and other typically very light areas should be neutral and reproduce any detail present in the original scene. While highlight areas are affected by color balance, density, and contrast, they are also affected by the inherent D-min level of the print material, solution contamination, product keeping (both before and after processing), and improper fixing or stabilization.
5. **Shadow Areas—**Black or high-density gray areas are close to neutral and reproduce the detail of the original scene. Although these areas are affected by exposure, density, color balance, and contrast, they are also affected by keeping before and after processing, solution contamination, and improper bleaching or fixing.
6. **Color Saturation—**Ideally, colors in the photograph reproduce those of the original scene. They do not appear flat or "muddy." Color saturation is affected mostly by film exposure. Improper development, bleaching, and fixing, as well as contamination of these solutions, also affect it.



What Are Aim Values, Control Limits, and Action Limits?

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. If the density values meet or exceed 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.

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-balance spread is the density difference between the two most widely separated densities of the HD – LD plot. If the process exceeds the spread limit, stop processing customer work, and take corrective action.

Control Chart—A control chart is a plot of values calculated from the density readings of your control strips. It shows process variations from aim over a period of time. Plots on your control chart will confirm the control of your process or provide a clear record of variations to help you troubleshoot process problems.

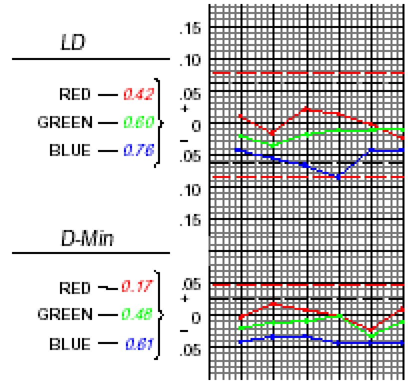
Control Limits—The control limits define the maximum tolerances that are acceptable for processing customer work. If any density value of your process plots beyond the control limit, the process is out of control, and results may be unsatisfactory for color, density, and/or contrast. When any density 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 of film or paper used to monitor your process.

Correction Factors—You use these numbers to adjust the densities of the reference strip to obtain aim values. Correction factors are provided with each box of control strips, and usually differ for each code number.

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



In the figure above, the black dashed lines are the action limits and the red dashed lines are the control limits.

WHAT CAUSES PROCESS CHANGES?

The aim of process control is to match the process with a standard, and then minimize changes from the standard.

Many factors can cause changes in your process and cause it to go out of control:

- Improper solution mixing
- Improper solution storage and keeping
- Incorrect processing solution temperature
- Incorrect processing time
- Improper agitation
- Improper solution replenishment
- Evaporation
- Equipment malfunction
- Contamination

Solution Mixing

Handle all chemicals carefully, and prepare each solution according to the instructions.

- Wear protective clothing
- Keep mixing tanks and equipment clean
- Calibrate mixing tanks
- Start with the correct amount of water at the proper temperature
- Mix solution parts in the correct order
- Mix solutions for the required amount of time

Solution Storage and Keeping

Solutions that are kept too long or exposed to air for too long may become exhausted. *Always follow the keeping recommendations given in the instructions provided with your chemicals or in the process control manual for your specific process.*

To minimize solution storage and keeping problems, mix only the amount of solution that you will use before the recommended keeping time is exceeded. Store mixed solutions in tanks with floating lids or in full, closed containers

Solution Temperature

Temperature variations greater than ±0.15°C (±0.25°F) in the developer of color processes will affect process control and image quality. In other solutions, temperature variations of a few degrees usually have no noticeable effect. However, variations greater than a few degrees can damage emulsions.

To avoid problems, use a consistent temperature for all your processing solutions. Use a temperature that you can maintain consistently.

Temperatures too high →	emulsion damage; density, color, and contrast changes; solution evaporation
Temperatures too low →	density, color, and contrast changes

Processing Time

Variations in processing time affect the film or paper in a manner similar to changes in temperature. Time in the developer is especially critical. While some safety factor is built into the times for other processing steps, excessively short times for washes, bleaches, bleach-fixes, fixers, and other steps will not allow these steps to complete their function. Use the proper times for all your processing solutions.

Time too long →	emulsion damage; density, color, and contrast changes; solution evaporation
Time too short →	density, color, and contrast changes

Agitation

Agitation is necessary in most solutions to maintain uniform activity by removing exhausted solution from the emulsion surface and replacing it with fresh solution. Agitation must be uniform throughout the processing tank.

Poor or insufficient agitation may result in non-uniformity and streaking on the film or paper. Too much agitation will oxidize some of the chemical components by introducing air into the solution. Excessive agitation is particularly harmful to developers. Follow your equipment manufacturer's recommendations for agitation.

Agitation methods involve moving the film or paper through the solution or moving solution over the surface of the film or paper. In continuous or roller-transport processors, the film or paper moves through the solutions. In rack-and-tank and sink-line processors, an inert gas (such as nitrogen) is bubbled through the solutions. Some bleach solutions require aeration to maintain activity.

Too much agitation →	solution oxidation; density, color, and contrast changes
Too little agitation →	density, color, and contrast changes; non-uniformity

Solution Replenishment

During processing, some components of the processing solutions are consumed or oxidized, and components from film or paper are dissolved into solution. In most processes, you can add replenisher solution to partially exhausted tank solutions to maintain the chemical compositions. The rate at which replenisher is added affects the solution activity and composition.

Most automatic processors provide a means of introducing the correct amount of replenisher into the tank. Be sure to replenish solutions properly. Check replenisher pumps and flow meters regularly to ensure that they are providing the correct amount of replenisher solution.

Over replenishment →	density, color, and contrast changes; higher chemical costs
Under replenishment →	density, color, and contrast changes

WHAT EQUIPMENT AND MATERIALS WILL YOU NEED?

To begin monitoring your process you'll need the following:

- Processing log
- Operator's checklist for your processor
- Maintenance checklist for your processor
- Processing manuals for appropriate processes
- Traditional KODAK Process Record Form, Y-Forms (or similar graph paper) with red, green, and blue pencils; or automated software
- Densitometer
- Control strips and reference strip
- Graduated cylinders
- Thermometer

Processing Log

Maintain a processing log by recording significant events that could affect process quality. Record the amount and type of film or paper processed each day or shift. A processing log should include information such as—

- Date and time of processing
- Size and type of film processed
- Amount of film or paper processed
- Times when control strips were processed
- Amount of replenisher used
- Preparation of chemical mixes
- Operator's name or initials

Operator's Checklist

An operator's checklist is a guide, a reminder, and a record of the routine procedures for starting up and shutting down your processor. Following a complete checklist will help ensure that your process is started up consistently. Failure to use a checklist, particularly at startup, can result in customer film being processed when the machine is not in proper operating condition.

Maintenance Checklist

Regularly scheduled maintenance helps keep your processor in good working condition. Follow the recommendations of the processor manufacturer. Included in maintenance checklists are items such as-

- Lubrication
- Filter replacement
- Tank cleaning
- Operating checks

Processing Manuals

Kodak publishes processing manuals that describe how to operate and monitor processes that use KODAK Chemicals.

They include:

- A list of KODAK Chemicals available for a particular process
- Recommendations for solution mixing and storage
- General processing recommendations
- Process options
- Solution-regeneration information (if applicable)
- Process-monitoring methods
- Troubleshooting and diagnostic information

Pub No.	Process	Publication
Z-100	C-41and RA-4	*Using KODAK Chemicals in Minilabs*
Z-101	C-41SM RA-2SM	*Using KODAK SM Chemicals in SM Mini-labs*
Z-130	RA-4	*Using KODAK EKTACOLOR Chemicals*
Z-131	C-41	*Using KODAK FLEXICOLOR Chemicals*

The most up-to-date versions of these manuals are available on-line at www.kodak.com/go/processcontrol.

Kodak has other process variations that are described in Customer Information Summaries (CIS). They are available at www.kodak.com/go/processcontrol.

KODAK Process Record Form, Y-Forms

This record form is graph paper designed for plotting variations from aim of the densities of process control strips. It has space to record aim values, the code number of the control strips, and the identification of the process and machine. It includes areas for plotting the variations from aim and dates processed for up to 23 control strips. It is available in pads of 100 forms.

Forms can be ordered from KODAK Advertising Distribution, or on-line at www.kodak.com/go/processcontrol

Available Y- Forms listed below:

CAT 176 9314 Y–30 used for Black-and-White Film process

CAT 144 6004 Y–33 used for Process E-6

CAT 148 3775 Y–34 used for Process E-6 first developer

CAT 158 0026 Y–35 used for Process E-6 reversal bath

CAT 194 2234 Y–36 used for Process E-6 color developer

CAT 171 3080 Y–55 C41 used for Process C-41

CAT 155 7164 Y–55 used for Process RA-4

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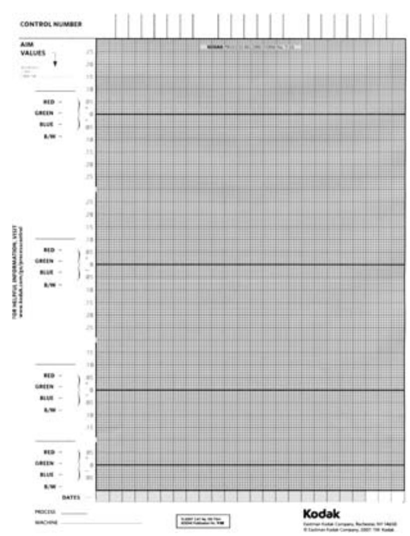
Densitometer

For process monitoring, you will need a reliable, accurate color densitometer that provides Status A and Status M densitometry. Status A filters are used to measure the densities of color reversal films and color papers or materials intended for viewing by transmitted or reflected light. Status M filters are used to measure the densities of color negative films. These standards are usually built in to commercially available densitometers.

Set the densitometer in the transmission mode to measure the densities of film; set it in reflection mode to measure the densities of prints. Monitor your densitometer regularly to be sure that it is operating properly. See “Checking Your Densitometer” in a later section.



Control Strips and Reference Strip

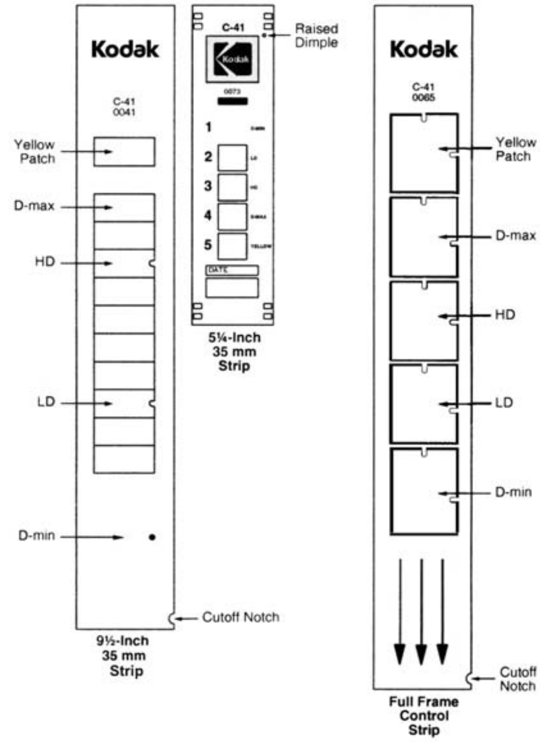
KODAK Control Strips are precisely exposed strips manufactured on uniform pieces of film or paper. The strips contain exposures made at several different exposure levels or steps.

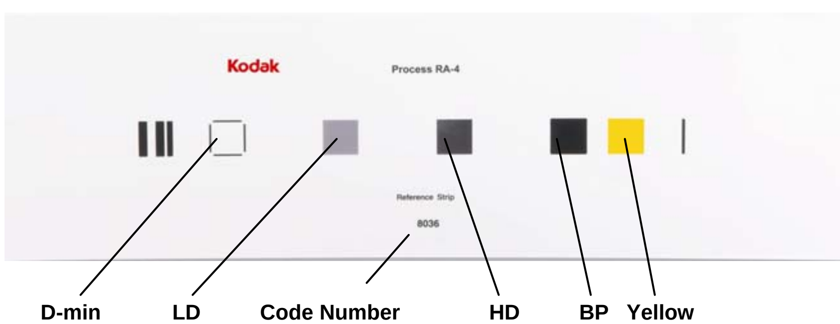
Each type of control strip is designed for a specific process, because each process has different requirements. Most strips include areas for reading minimum density (D-min) and high and low mid-range densities for process monitoring. Storage conditions can affect the quality and usefulness of these strips for process control. Follow the specific storage requirements noted on each package of KODAK Control Strips.

Store unused KODAK Control Strips, Process RA-4 in frozen storage at a temperature of -18°C (0°F). Store unused KODAK Control Strips, Process C-41 in refrigerated storage at a temperature between 4° to 13°C (39°F to 55°F). Remove only a day's supply of strips at a time, reseal the package, and immediately return the package to the appropriate cold storage. Discard any unused strips at the end of the day. If problems occur from condensation, allow the package to warm up to room temperature before you open it.

A reference strip and correction factors are supplied with each box of KODAK Control Strips. The reference strip is exposed on the same emulsion and under the same conditions as the control strips and has already been processed in a standard process. A code number on the box label and the reference and control strips identifies each batch of strips.

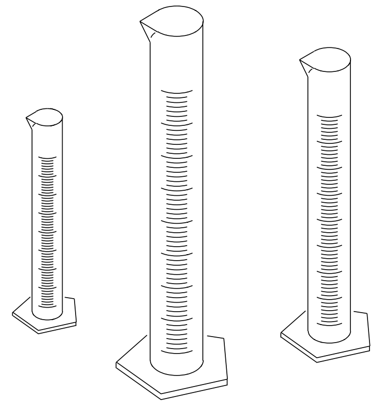
You'll determine aim values for your process by applying the correction factors to your densitometer readings of the reference strip. Then you'll plot the densitometer readings from control strips processed in your machine against these aim values to monitor your process.





Graduated Cylinders

Use a graduated cylinder calibrated in ml to measure small volumes of solutions. You can also use a 250 mL or 500 mL graduated cylinder to measure the output of automatic replenishment systems. Calibrate small mixing tanks with a 1-litre graduated cylinder.



Thermometer

Use a thermometer calibrated in 0.1°C units, such as the ASTM No. 91C or Fahrenheit equivalent, to calibrate temperature controls and check solution temperatures.

HOW DO YOU MONITOR A PROCESS?

Process monitoring is a method of regularly checking the condition of your film and paper processes to ensure that they are operating according to a standard that Kodak has defined with aims built into the reference strip. It helps prevent losses by detecting potential problems. To monitor your process, you will process control strips, measure specified densities, and then compare the densities to aim values. You will plot your variations from aim on a control chart. Your control chart will do the following:

- Define the action and control limits as acceptable limits
- Show trends in the process and signal you to make changes to keep the process in control
- Help determine the causes of process problems
- Allow you to check the effects of adjustments made to the process

Process monitoring involves these basic steps:

1. Establishing an aim or standard for your process
2. Determining the condition of your process relative to the aim
3. Keeping an ongoing record of the condition of your process and analyzing the record daily
4. Taking corrective action when variations from aim are outside the action limits on your control charts—you will verify the results of the correction to be sure that the process is within the action limits.

Establishing an Aim for Your Process

The reference strip packaged with your control strips is the primary tool for establishing aim values for your process. Follow the procedure below to establish your aim values.

1. Remove the reference strip from the box of control strips. If you have a number of boxes with the same code number, remove the reference strip from several boxes. You can minimize the effects of variability by averaging the density readings of all of the reference strips.

   IMPORTANT: After removing the reference strip, return the control strips to cold storage. Then allow the reference strips to warm up to room temperature before removing them from the envelope. Exposing a cold reference strip to warm, moist air can cause low density readings, especially in the high-density patches. Store the reference strips in the envelopes at room temperature after you make your densitometer readings.

2. Use a precision electronic densitometer to measure the red, green, and blue densities in the center of the patches recommended in the instructions supplied with the strip. Do not move the strip while taking the readings. Average the readings if you read more than one reference strip from the same code number.
3. Apply the correction factors supplied with the control strips to the average readings from step 2 to obtain your aim values. Write these values in the appropriate spaces on the left side of the KODAK Process Record Y-form.

For further information on setting aims for a specific process cycle, see the KODAK Publications listed on page 9.

Preparing a Control Chart

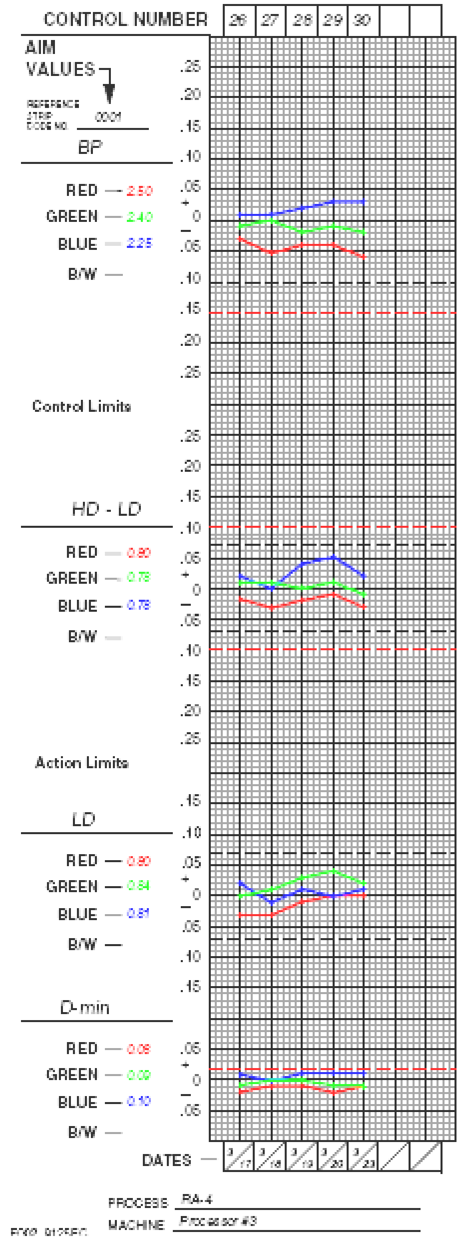
Do not try to predict film or print quality from your control charts alone. A good monitoring program uses control charts or print evaluation in decision-making. However, a control chart is essential to detecting and eliminating process problems and distinguishing them from other factors such as printer problems. Compensating for process deviations by adjusting printer setups will not result in optimum print quality.

To prepare a control chart on the KODAK Process Record Y-Form,

1. Use a separate form for each processor
2. Record the reference-strip code number and the aim values in the appropriate blanks. Use red, green, and blue pencils when you record the aim values
3. Draw horizontal lines to represent the action and control limits
4. Record the process and machine identification in the blanks at the bottom of the form
5. You'll need to record the date and time that each control strip is processed. Plot the control-strip values against the aim values, and connect the points to give a continuous graph

To help determine the cause of a control problem, also keep records of—

- Machine speed or solution time
- Solution temperatures
- Agitation
- Filter replacements
- Squeegee adjustments
- Maintenance of racks, gears, pumps, lines, etc.
- Operators
- Chemical mixes
- Replenishment rates
- Film types, sizes, and amounts
- Silver-recovery procedures
- Solution adjustments (e.g., pH, chemical additions, etc.)



Comparing Your Process to the Aim Values

When you've created a control chart as described above, follow the procedure below:

1. Follow this schedule for processing a control strip:
   - At the beginning of the day or shift, before processing customer work

   Also consider processing a control strip at:
   - Regular intervals with customer work
   - The end of the day or shift

Note: Each time you process a control strip; position it in the same location in your processor.

2. When the control strip is processed and dried, use a precision electronic densitometer to measure the red, green, and blue densities in the center of the patches you measured on the reference strip when you established your aims. **Do not** move the strip as you make the density readings or you may affect the precision and repeatability of the measurements.
3. 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

To avoid processing customer film in an out-of-control process, read and plot control-strip densities immediately after you process a strip. Analyze the plots to detect trends that may lead to an out-of-control condition. This will enable you to check for sources of the trend and take the proper action if your plots exceed the action limits.

Verify out-of-control plots by processing another control strip. Seldom do two consecutive plots provide false data.

Interpreting Control Charts

In interpreting control plots, the primary concern is a plot that exceeds the action or control limits. Fluctuation of the plots within the action limits is normal and no action is required. If any single plot exceeds the action limit or the control limits, take the following steps before making any process adjustments:

1. Check that the control strip you processed is of the same code number as the reference strip used to establish aims.
2. Check that the control strips were stored and handled properly.
3. Check the densitometer to be sure that it is calibrated and operating properly.
4. When you have verified that there is no problem with the control strip or the densitometer, re-read the control strip.
5. If the readings from step 4 verify the results, process another control strip.
6. If the second strip confirms the original results, do the following:
   - If the plot exceeds the **action limits**, you can continue to process customer orders, but you must determine the cause of the process shift and correct it. Note any corrective action that you take on the control chart. When the process is in this condition, we recommend that you process a control strip with each batch of customer work.
   - If the plot exceeds the **control limits**, do not process any customer work until you have corrected the out-of-control condition.
7. 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.

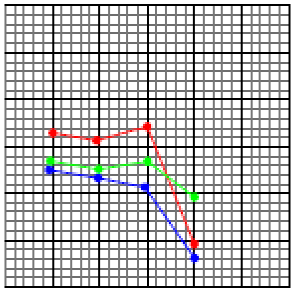
The causes of some common conditions are described under "What Can You Do To Correct Process Problems?" The Kodak processing manuals for individual processes include detailed information for diagnosing and correcting process problems.

WHAT CAN YOU DO TO CORRECT PROCESS PROBLEMS?

Sudden Change in Density

Some processing conditions can produce sudden changes in one or more points of the control plot. These include the following:

- Using a control strip with a code number different from that of the reference strip
- An increase or decrease in developer temperature
- An incorrect processing time, particularly in the developer
- Solution contamination of the developer tank

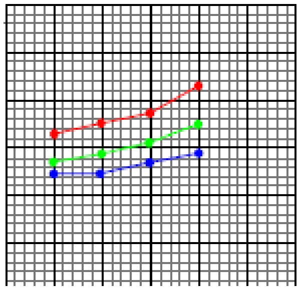


Trend of Increasing or Decreasing Density

Trends in the control plots are the result of gradual changes in processing conditions. Trends usually indicate changes to your process chemicals. A trend of increasing or decreasing density is usually traceable to the developer in a color negative process.

The most likely causes are—

- Incorrect developer replenishment rate
- Improper mixing or storage of the developer replenisher
- Improper storage of the control strips

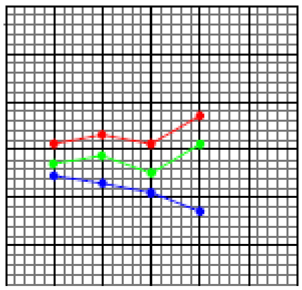


Trend of Increasing Spread Between Densities

When the red, green, and blue plots spread as they move in an upward or downward direction, one color is becoming proportionally more or less dense than the others. The processed work will show this change in color balance.

The cause of this type of trend is usually traceable to the developer in a color negative process. The most likely causes are—

- Improper mixing or storage of the developer replenisher
- Contamination of the developer replenisher
- Incorrect replenishment rates
- Oxidation of the developer



WHAT OTHER CONTROL METHODS ARE HELPFUL?

Several simple methods are available for checking the condition of your processing solutions and equipment to make sure that they are within operating specifications.

These methods use simple equipment and procedures. They include—

- Checking the calibration of your densitometer
- Calibrating flow meters and pumps
- Calibrating mixing tanks
- Checking for mixing errors with specific gravity

Checking Your Densitometer

Calibration and maintenance of your densitometer are very important, because an inaccurate density reading can be misinterpreted as a process change. To monitor your densitometer and/or enable readings from two or more densitometers to be reliably compared, check your densitometer(s) regularly. See your manufacturer's recommendations for the calibration procedure.

Calibrating Replenishment Pumps

For machines with automatic or semiautomatic replenishment, check the settings on the replenisher and pumps once per month, readjust them as needed, and calibrate each pump to insure the volume of replenisher solution or wash water delivered for a particular setting is accurate.

KODAK CONTROL STRIPS

KODAK Control Strips are available for monitoring many processes. A brief description of each of the most widely used strips is given below.

KODAK Control Strips, Process C-41, CAT 180 3709

Use KODAK Control Strips, Process C-41 to monitor processes C-41, C-41B and C41-RA. Strips are available in 35 mm x 100-foot rolls of approximately 120 strips with cutoff notches at 9 1/2-inch (24.1 cm) intervals. The rolls are wound *emulsion side in*, with the D-min end of the density scale toward the outer end of the roll.

Each strip has 12 steps—a yellow step, a D-max step, and 10 equal-increment neutral-density steps. Step indicators identify the LD and HD steps.

KODAK Control Strips, Process C-41, Cassettes Box of 5 Cassettes, CAT 824 5508

Strips are supplied in 35 mm cassettes for minilab film processors.

Each cassette contains a 24-exposure length roll and the same exposure format as in the 9 1/2-inch strip.

KODAK Full Frame Control Strips, Process C-41, CAT 157 6701

These strips are primarily designed for use with minilab system printers that use a film scanner as a built-in densitometer. However, you can use them with any densitometer.

These 35 mm strips are supplied in 100-foot rolls of approximately 80 strips with cutoff notches at 15-inch (38.1 cm) intervals.

Each strip has five full-frame density steps: D-min, LD, HD, D-max, and yellow.

KODAK Full Frame Control Strips, Process C-41, CAT 173 4508

These 35 mm strips are supplied in 50-foot rolls of approximately 40 strips with cutoff notches at 15-inch (38.1 cm) intervals

KODAK Control Strips, Process RA-4,

Box of 50, CAT 828 2170
Package of 5, CAT 801 0126
Package of 25, CAT 898 2746

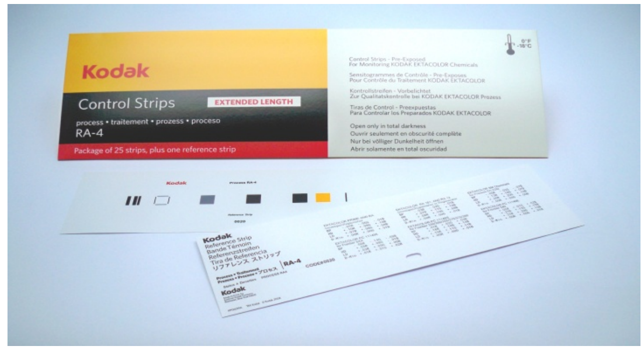
Use these strips to monitor Process RA-4. They are available in three formats, a box of ten moisture-resistant envelopes that contain five strips each, a package containing five moisture-resistant envelopes of five strips, and a package containing one moisture-resistant envelope of five strips. All offerings include a Reference Strip and correction factors for several RA Processes. Use the correction factors to calculate the aim values for this batch of strips.

Each control strip, reference strip, and box label is marked with a code number. The code number identifies the strips as part of a particular batch.

Each strip measures 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.

KODAK Control Strips, Process RA-4 / Extended Length, CAT 130 4690

These strips are nominally 13.75 inches as compared to the standard paper control strips length of 12 inches. These strips are for use in processing equipment which requires a strip longer than 12 inches, such as various models of Fuji Frontiers.



They are available in a package containing five moisture-resistant envelopes of five strips, a Reference Strip and correction factors for several RA Processes. Use the correction factors to calculate the aim values for this batch of strips.

Each control strip, reference strip, and package is marked with a code number. The code number identifies the strips as part of a particular batch.

Each strip measures 3 1/2 x 13.75 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.

KODAK PROFESSIONAL Pro Strips Color Negative Paper Control Strips, Process RA-4, CAT 129 8587

These strips are optimized for Kodak Professional color negative papers and display materials.

Each box contains a Reference Strip and correction factors. Use the correction factors to calculate the aim values for this batch of strips.

Each control strip, reference strip, and box label is marked with a code number. The code number identifies the strips as part of a particular batch.

They are available in a box of ten moisture-resistant envelopes that contain five 3 1/2 x 12-inch strips each. Each strip has 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. Low bleach-fix activity will make the yellow patch appear brown and less saturated than normal.

KODAK PRINTER CONTROL TOOLS

KODAK Printer Control Tools are available for monitoring many Optical and Digital printers. A brief description of each of the most widely used tools is given below

Printing Recommendations

There are general recommendations you should consider to achieve improved results when printing customer film. Many film manufactures have improved film quality and you need to set-up your printer and processors to deliver this improved quality. When printing these films on your optical or digital printers "good" results can be obtained with a well set-up "family" film channel. Depending on your particular processor and printer characteristics, KODAK GOLD Films may all print "good" on this "family" channel. Better results may be obtained by developing individual channels for each film, as necessary. You should consider individual channels for your premier films or problem films.

If your printer is capable of using individual film channels, use the following procedure to help set-up and maintain these channels. You can obtain Printer Balancing Kits that include many KODAK Films and the procedures to set-up and maintain these channels. Discuss this with your Kodak representative. If you cannot obtain the necessary kits, you may set-up and optimize your channels by copying an existing "family" channel and changing it for use with the film of interest. You can then optimize this channel by reviewing your customer work for color and density problems and applying a change to the channel to correct these errors. Discuss this with your Kodak and equipment representatives. Always be aware of the quality of your customer work and make the necessary changes to your printer, processor, or workflow as necessary.

The following KODAK Tools can be helpful in set-up and monitoring printers and film channels. Discuss these tools and possible solutions with your Kodak representative.

Introduction to Color Process Monitoring for Minilabs
KODAK Publication No. **Z-99M**

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