USING *KODAK* CHEMICALS IN MINILABS

Kodak

This publication is written specifically for minilab operators. It provides the most commonly needed technical information about film and paper processes for minilabs.

Using KODAK FLEXICOLOR Chemicals and KODAK EKTACOLOR Chemicals in your minilab ensures that your film and paper processes will provide optimum results with the least possible environmental impact.

This manual contains information on the film processing cycles recommended for KODAK GOLD, ULTRA MAX, ADVANTiX, and KODAK PROFESSIONAL Films. Also, this manual contains information on paper processing cycles for KODAK EDGE and ROYAL Papers. It is divided into four sections:

- Chemicals and Chemical Handling
- Processing Cycles for KODAK Chemicals
- Process Monitoring
- Troubleshooting Processes C-41 and RA-4

Note: If you are using KODAK SM Chemicals, see KODAK Publication No. Z-101, *Using KODAK SM Chemicals in SM Minilabs*.

If you are using a KODAK Minilab System 88 or 89, a KODAK PROFESSIONAL RP 30 Laser Printer, a KIS DKS minilab system, a Fuji Frontier, or a Noritsu printer/processor designed for Process CP-48 or CP49E, you will find technical information on using KODAK Chemicals in those systems at www.kodak.com/go/photochemicals under the "Technical Publications" tab.

1 CHEMICALS AND CHEMICAL HANDLING

High-quality customer orders begin with proper chemical handling and your choice of chemicals. Chemical handling includes how you store and mix chemicals and your attention to chemical safety.

This section explains the following:

- Chemical terms
- Effects of processing solutions
- Choosing the right chemicals for your processes
- Safe handling of photographic chemicals
- Chemical mixing
- Chemical storage
- Chemical characteristics
- Compensating for evaporation
- Cleaning tanks and racks
- Disposing of processing effluent
- Silver recovery
- Solid-waste disposal

CHEMICALS TERMS

To help you understand the terms we've used to describe the chemicals in this manual, here are some definitions:

Chemical Concentrates or Concentrate—Concentrated chemicals that are diluted to make tank solutions or replenishers.

Fresh Solution—Newly mixed, unused solution.

Replenisher—Solution used to restore the chemical components of the tank solution to maintain photographic performance over time.

Seasoned Solution—A tank solution that has been used and replenished for a period of time. The chemical components and seasoning by-products of a seasoned solution are at an optimum level for processing.

Starter—A concentrate that is added during preparation of a fresh tank solution so that it will yield results similar to those provided by a seasoned tank solution.

Tank Solution—The solution used in the processor tank; often referred to as "working solution."

EFFECTS OF PROCESSING SOLUTIONS

Each solution affects the film or paper differently. Understanding the function of each solution can help you diagnose processing problems.

Developer

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

The amount of cyan, magenta, and yellow dye formed depends on exposure and developer activity. Temperature, time, concentration, replenishment rate, 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; with *too little* activity, not enough dye forms.

Bleach

In the film process, the bleach stops developer activity and converts metallic silver produced in the developer step into 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 into an active form.

If bleaching is inadequate, it can cause retained silver because not all of the metallic silver is converted to silver halide. This can effect the scanning and printing of films, causing an overall increase in the contrast of the print, as well as causing highlight areas to be lacking in detail. Retained silver is caused by a bleach cycle time that is too short, a bleach temperature too low, or a bleach that is too dilute, underreplenished, or not aerated adequately.

Bleach Areation—In Process C-41, you must aerate the bleach to convert the less active iron II into more active iron III. If aeration is inadequate, it can contribute to retained silver and leuco-cyan dye problems, as well as causing staining by-products that will increase the D-min density of processed films. Too much aeration can cause the bleach to foam and splash, which can contaminate other solutions, and also form developer "tar" particles (oxidized developer) that can adhere to the film.

Fixer
In a film process, the fixer converts silver halide in the film into soluble silver complexes. Most of these silver complexes remain in the fixer solution; you can recover them with electrolytic silver-recovery units, metallic replacement cartridges, and/or chemical precipitation methods.

Fixing efficiency depends on fixer activity and the diffusion rate into and out of 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 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 D-min densities of the control plot, the original fixer is probably exhausted.

The most probable causes of inadequate fixing are fixer underreplenishment, a fixer that is too dilute due to excessive solution carryover or improper mixing. Also, when fixer becomes exhausted, it can break down and form particles of sulfur and silver sulfide, a condition called "sulfurization."

Bleach-Fix
The paper process uses a bleach-fix instead of a separate bleach and fixer. A bleach-fix has three primary purposes: to stop the action of the developer; to convert metallic silver into silver halide; and to dissolve the silver.

Bleach-fix performance depends on the bleach-fix concentration and the diffusion rate of the solution into the emulsion. Time, agitation, and temperature affect the diffusion rate.

Inadequate bleach-fixing may not remove all of the silver from the paper. A sign of retained silver is an increase in the black-patch (BP) densities and a desaturation of the yellow patch on the control strip (giving it a brown appearance). Retained silver degrades image quality by desaturating the colors—especially yellow—and is most apparent in higher-density areas where there is more retained silver. You can remove retained silver by reprocessing the paper in a good bleach-fix.

Final Rinse
In a film process, the final rinse promotes uniform drying and reduces water spotting. In minilabs that use a washless film process, the final rinse (instead of a wash step) removes residual chemicals from the film.

Stabilizer
In a paper process, the stabilizer permits low wash rates and maintains a clean working solution to avoid dirt and stain formation on the prints.

Wash
Most minilabs operate without a wash step; however, some older minilabs use wash water to remove residual chemicals from film or paper. 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 it damages the emulsion. A thorough final wash is necessary because chemicals that remain in the film or paper can cause dyes to fade.

CHOOSING THE RIGHT CHEMICALS FOR YOUR PROCESSES

Kodak is committed to providing minilabs with chemicals that are safe, economical, and easy to use. The chemicals designed for minilabs are supplied in liquid concentrates for easy mixing and handling; they are available in convenient and economical sizes. Kodak designs these chemicals to be as safe as possible for our environment.

KODAK FLEXICOLOR Chemicals for Minilab Film Processors
KODAK FLEXICOLOR Chemicals are designed for processing all Kodak color negative films.

FEATURES	BENEFITS
• All-liquid concentrates	• Easy mixing
• Low developer replenisher rates with FLEXICOLOR LU Developer Replenisher LORR	• Less mixing • Less elluent discharge—less environmental impact • Chemical savings • Robust performance when operating in Low Utilization conditions
• Rapid-access cycle time for some minilabs with FLEXICOLOR RA Chemicals	• Faster turnaround time for customer orders • Designed for use in minilabs using Process C-41RA, or older minilabs using Process C-41B
• Odorless bleach with FLEXICOLOR RA Bleach Replenisher NR	• Better workplace environment
• Availability of washless cycle	• No need for water or sewer hookup • Savings in water and energy costs
• Excellent performance when mixed with a variety of water supplies	• Quality of local water supply not critical
• Wide variety of sizes	• Sizes convenient for all users

Kodak packages the following FLEXICOLOR Chemicals in convenient sizes for minilabs. For information on process cycles and production volume, see page 2-1.

KODAK Chemical	Process Cycle	Sizes to Make*	Comments
FLEXICOLOR LU Developer Replenisher LORR	C-41B, C-41RA, C-41	5 L, 10 L	Low replenishment rate helps reduce effluent discharged by as much as 50 percent; less chemical mixing and lower cost per roll of film processed.
FLEXICOLOR Developer Starter LORR	C-41B, C-41RA, C-41	31.5 L (8.3 gal) of tank solution	Use with FLEXICOLOR Developer Replenisher LORR to prepare fresh tank solution.
FLEXICOLOR RA Bleach Replenisher NR	C-41RA, C-41B	5 L	Use with minilabs designed for Processes C-41RA and C-41B. Requires no mixing; packaged ready to use; odorless.
FLEXICOLOR Bleach Starter	C-41RA, C-41	31.5 L (8.3 gal)†	Use with FLEXICOLOR RA Bleach Replenisher NR. Odorless, non-corrosive, and non-foaming. One bottle will make 31.5 L (8.3 gal)* of tank solution.
FLEXICOLOR RA Fixer and Replenisher	C-41RA, C-41B	5 L, 10 L	Use with minilabs designed for C-41RA and C-41B. Use as replenisher or tank solution.
FLEXICOLOR Final Rinse and Replenisher	C-41B, C-41RA, C-41	5 L, 10 L	Contains surfactants to reduce drying marks; resists biological growth for cleaner solution, less maintenance.

* Sizes listed are available in the U.S. and Canada. Other regions may supply these chemicals in different sizes; for more information, contact Kodak in your country.

† From FLEXICOLOR RA Bleach Replenisher NR.

KODAK EKTACOLOR PRIME and EKTACOLOR RA Chemicals for Minilab Paper Processors

FEATURES	BENEFITS
• Fast access time	• Quicker results from printer test
• Low replenisher rates	• Fewer mixes • Less elluent discharge—less environmental impact • Chemical and cost savings
• Lower water usage	• Reduced water and energy costs • Less effluent discharged
• Availability of washless cycle	• Additional water and energy savings; smaller amounts effluents discharged
• Greater process stability	• Consistent, repeatable print quality over a broad range of processor production volumes • Less need to adjust for low production volumes • Fewer printer changes due to process shifts
• Preservatives to protect developing agent from oxidation	• Stable developer activity
• Good mixes with a variety of water supplies	• Quality of local water supply not critical
• Stain-reducing agent	• Clean, crisp whites in prints

Kodak packages the following EKTACOLOR Chemicals in convenient sizes for minilabs. For information on process cycles and production volume, see page 2-1.

KODAK Chemical	Process Cycle	Sizes to Make	
EKTACOLOR PRIME SP Developer Replenisher LORR	RA-4	10 L, 20 gal	For minilabs with medium to high production volume. Reduced replenishment rate.
EKTACOLOR RA Developer Replenisher RT	RA-4	10 L	For minilabs with very low production volume. For minilabs with roller-transport design. Formulated to minimize the effects of low production volume.
EKTACOLOR RA Developer Starter	RA-4	Available in 80 oz. (2.366 L) bottle	One bottle makes 59 L (13.9 gal) of tank solution from KODAK EKTACOLOR PRIME SP Developer Replenisher LORR or 95 L (25 gal) of tank solution from EKTACOLOR RA Developer Replenisher RT.
EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR	RA-4	5 L, 10 L, 10 gal	For minilabs with medium to high production volume.
EKTACOLOR PRIME SP Bleach-Fix Starter	RA-4	To make 20L	Use only with PRIME SP Bleach-Fix Replenisher LORR to prepare a tank solution.
EKTACOLOR RA Bleach-Fix and Replenisher	RA-4	10 L	For minilabs with very low production volume.
EKTACOLOR PRIME Stabilizer and Replenisher LORR	RA-4	5 L, 10 L	For use in place of final wash in washless minilabs.

* Sizes listed are available in the U.S. and Canada. Other regions may supply these chemicals in different sizes; for more information, contact Kodak in your country.

SAFE HANDLING OF PHOTOGRAPHIC CHEMICALS

Handle all chemicals carefully. For more information about potential health hazards and safe handling of specific Kodak chemicals, see the package label and the Material Safety Data Sheet (MSDS) for the chemical. MSDSs are available online at **www.kodak.com/go/msds**.

Follow Instructions Carefully. Kodak chemical packages have precautionary information on the labels. Always follow the label instructions.

Store Chemicals and Processing Solutions Safely. Keep chemicals and processing solutions out of the reach of children and pets. **Do not** store chemicals where you handle or store food. **Do not** eat, drink, or smoke in chemical-handling areas. Always wash your hands thoroughly after handling chemicals, especially before eating or drinking.

Label All Chemicals Properly. In the U.S., the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard requires employers to inform employees about hazardous chemicals in the workplace. This standard requires that all containers of hazardous chemicals, including storage and processor tanks, be labeled. You can obtain downloadable versions of the labels online at **www.kodak.com/go/kes**. These labels give the chemical hazard and the action to take in case of accidental contact. Use these labels *only* for KODAK Chemicals; use with other manufacturers' chemicals is an incorrect use under the OSHA standard. Other countries may have similar requirements, so check with local authorities or Kodak in your country.

Keep the Mixing Area Clean. Clean up spilled chemicals as soon as possible with mild soap and water; wear nitrile rubber gloves and goggles. Residue from dried chemicals can become airborne and be inhaled or contaminate processing and printing areas.

Wear Protective Equipment and Clothing. Wear goggles or a face shield and an apron (made of PVC) and protective gloves (made of nitrile rubber) when you mix solutions. Clean protective clothing after use to remove any chemical residue that can cause contamination.

Handle Chemicals Carefully. Avoid prolonged contact of any chemicals with your skin; some photographic solutions, particularly developers, can cause skin irritation and an allergic skin reaction. In case of accidental chemical contact, wash your skin with running tap water and a non-alkaline (slightly acid) hand cleaner. If symptoms persist, get medical attention. An eyewash station must be handy to all employees. The station must be capable of providing a 15-minute flush of water or eyewash fluid at a rate of 1.5 litres/minute. All employees must know the

location of the eyewash station. Follow the manufacturers' instructions for eyewash station maintenance, and inspect the unit on a routine basis as required by OSHA.

Ventilate the Area Properly. Some photographic chemicals and solutions give off vapors and gases. For safety and comfort, keep the concentration of these vapors and gases to a minimum. To minimize the concentration of vapors and gases, provide good ventilation and use covers and floating lids on all solution storage tanks (which also helps reduce evaporation and oxidation). Also, keep the processing tanks enclosed and vent the dryer according to the manufacturer's specifications.

Additional Health and Safety Information. If you are interested in obtaining publications from Kodak that address the subject of the Safe Handling of Photographic Chemicals, please visit our website at **www.kodak.com/go/kes**.

CHEMICAL MIXING

For the most current information, follow the mixing instructions packaged with the chemicals or on the label of the chemical container. Follow all safety precautions and handling recommendations given in the instructions and under "Safe Handling of Photographic Chemicals" on page 1-6.

Contamination Can Ruin a Process. To minimize the possibility of contamination, keep processing and mixing equipment and storage containers clean. Dirt and contamination can affect the life and photographic quality of the processing solutions. Avoid conditions where solutions can come in contact with other chemicals. Small amounts of fixer or bleach-fix solution can contaminate developer solutions and cause adverse photographic effects.

To lessen the possibility of contamination, thoroughly rinse and clean processing and mixing equipment and storage containers before use. Be careful not to drip solution into other tanks when you remove racks for cleaning. Wash and rinse processing and mixing equipment thoroughly before reusing it.

Contamination is most often caused by—

- solution splashed or dripped into another solution
- using mixing equipment that has not been thoroughly cleaned
- dry chemicals that become airborne during mixing
- pipes and tanks made of material that reacts with the photographic chemicals

CHEMICAL CHARACTERISTICS

Fresh FLEXICOLOR and EKTACOLOR Chemical concentrates and solutions have a characteristic appearance and odor. By checking the appearance and odor, you may be able to determine if a concentrate was stored properly. The tables on page 1-8 summarize the characteristics of FLEXICOLOR and EKTACOLOR Chemical concentrates.

Characteristics of KODAK FLEXICOLOR Chemical Concentrates

FLEXICOLOR Chemical	Appearance of Concentrate	Appearance of Mixed Replenisher	Comments
LU Developer Replenisher LORR	Part A—Clear, colorless	Pale yellow to amber	Darkens slightly with age/storage; this will not affect activity. If appearance of Part C concentrate is dark opaque, solution is oxidized, do not use.
	Part B—Clear, colorless		
	Part C—Clear, pale yellow to amber; strong odor of sulfite		If mixed replenisher is dark opaque, it is oxidized, do not use.
Developer Starter LORR	Clear, colorless; odorless	—	—
RA Bleach Replenisher NR	Dark yellowish-green; odorless	Dark yellowish green	Ready-to-use as replenisher. If concentrate is exposed to temperatures below 4°C (40°F), precipitate may form. This precipitate may not dissolve at room temperature.
Bleach Starter	Clear, colorless; odorless	—	—
RA Fixer and Replenisher	Clear, colorless to pale yellow/green; slight ammonia odor	Clear, colorless to pale yellow/green	Age, exposure to high temperature, or oxidation can cause sulfurization. Severely degraded fixers can produce a large amount of white to yellow precipitate (sulfur) and may have a hydrogen sulfide odor (i.e., rotten egg odor).
Final Rinse and Replenisher	Clear, colorless to pale cyan	Clear, colorless	Solution readily foams.

Characteristics of KODAK EKTACOLOR RA Chemicals

EKTACOLOR Chemical	Appearance of Concentrate	Appearance of Mixed Replenisher	Comments
PRIME SP Developer Replenisher LORR	Clear, yellow to orange to orange brown; fresh odor	Pale amber to amber	Darkens slightly with age/storage; this will not affect activity. If appearance is dark opaque, solution is oxidized, to not use
Developer Replenisher RT	Part A— Clear, yellow to reddish amber; amine odor	Pale yellow to amber	Darkens slightly with age/storage; this will not affect activity. If appearance of Part B concentrate is dark opaque, solution is oxidized, do not use. If mixed replenisher is dark opaque, it is oxidized. Do not use.
	Part B— Clear, amber to tan; suflite odor		
	Part C— Clear, colorless;odorless		
Developer Starter	Clear, colorless;odorless	—	—
PRIME SP Bleach-Fix Replenisher LORR	Dark red-brown; slight acetic acid odor	Dark red-brown	Do not allow concentrate to freeze as precipitates may form. Age, exposure to high temperature, or oxidation can cause sulfurization. Severely degraded bleach-fixes can produce a large amount of white to yellow precipitate (sulfur) and may have a hydrogen sulfide odor (i.e., rotten egg odor). If sulphur is seen, do not use.
Bleach-Fix Replenisher	Part A—Clear, colorless, slight ammonia odor	Dark red brown	
	Part B—Dark red-brown		
PRIME SP Bleach-Fix Starter	Dark red-brown	—	—
PRIME Stabilizer and Replenisher LORR	Clear, colorless to pale green	Clear, colorless	—

Chemical Storage

- Store *chemical concentrates* at 7 to 30°C (45 to 86°F) in a dry location. At temperatures lower than 7°C (45°F), components may come out of solution or crystallize. Temperatures higher than 30°C (86°F) will accelerate chemical reactions and cause deterioration.
- Store *mixed replenisher solutions* in polyethylene storage tanks at approximately 21°C (70°F). Too high a temperature accelerates oxidation and evaporation. Too low a temperature can affect the temperature of the tank solution.
- To reduce oxidation and evaporation, use floating lids on all solutions.

For best results, *do not* use mixed KODAK FLEXICOLOR or EKTACOLOR Chemicals that have been stored longer than the times given in the table below.

Mixed Solution	Solution in Processor—No Operation	Replenisher in Covered Tank
FLEXICOLOR Developer LORR	1 week	4 weeks
ETKACOLOR RA Developer RT EKTACOLOR PRIME SP Developer LORR	1 week	6 weeks
All other solutions	2 weeks	8 weeks

COMPENSATING FOR EVAPORATION

When water evaporates from processing solutions, the chemical components remain and the solutions become overconcentrated. Some degree of evaporation occurs naturally, but it is most likely to occur at these times:

- when the processor is on and up to temperature, but no film or paper is being processed
- while the processor is cooling down immediately after shutdown

You can compensate for this evaporation by topping off the solution tanks with water. Use water at a temperature that is close to the temperature of the tank solutions. *Never use cold water to top off tank solutions.* The procedures below provide a helpful guide to compensating for evaporation that occurs over a 24-hour period.

Daily at Startup—With the recirculation system on, check the level of the tank solutions. If the level is not up to the top of the overflow tube, add water, at approximately operating temperature, to raise the level to the top of the overflow tube.

If the solution level is at the top of the overflow tube, squirt the top edges of the tank and the rollers at the top of the rack lightly with warm water to remove any buildup of dried chemicals. To avoid severely diluting the tank solution, be careful not to use too much water.

At Shutdown—Squirt the top edges of the tank, the top of the rack, and the rollers at the top of the rack lightly with warm water to prevent the buildup of dried chemicals. To avoid severely diluting the tank solution, be careful not to use too much water. Clean and rinse crossovers thoroughly to minimize chemical buildup.

CLEANING TANKS AND RACKS

Always wear splash-proof goggles and protective gloves and apron when you clean processor racks and tanks.

Routine Cleaning

Follow the recommendations described below. **Be sure to follow your equipment manufacturer's recommendations for regular maintenance procedures**.

1. Remove crossovers, squeegee rollers, or squeegees at shutdown, and rinse them with hot water.
2. Once a week, remove each rack from the processor, clean it with hot water and a soft, non-abrasive brush, and rinse thoroughly. Inspect the racks for non-moving rollers, deformities in rollers, worn or broken springs and gears, loose screws, deteriorated retaining clips, etc., to ensure smooth transport.
3. On a periodic basis (every 6 to 12 months), clean racks and tanks with a non-abrasive brush, and remove stains from racks and tank walls with a cleaner. Rinse racks and tanks thoroughly before you refill the tanks.

Removing Biological Growth

Biological growth can occur in stabilizer, final rinse, and wash tanks, and is a potential source of dirt. Clean wash tanks weekly, and stabilizer tanks as needed. Wear protective gloves and splash-proof goggles when you follow this procedure. To remove biological growth:

1. Empty the stabilizer or wash tank. Dispose of waste solutions according to local or state disposal regulations.
2. Rinse the tank and racks with hot water; drain the rinse water and repeat.

   DANGER! Do not add cleaning agents to processing tanks unless the tanks and racks have been completely drained and thoroughly rinsed with water. Read the Material Safety Data Sheet for more information on the potential hazards when cleaning the working tank.
3. Fill the tank with a dilute sodium hypochlorite (NaOCl) solution, such as 2 mL Clorox (5.25 percent NaOCl) per litre of water.

4. Allow the hypochlorite solution to remain in the tank for up to 30 minutes. Longer soaking times can damage plastic or rubber materials. After treatment, dispose of the hypochlorite solution according to local or state disposal regulations.
5. Brush foreign matter from tanks and racks.
6. Before refilling tanks, flush them thoroughly with water. Small amounts of remaining hypochlorite can have an adverse effect on processing-solution activity. Be sure to recirculate rinse water through the recirculation system to remove traces of hypochlorite.

Note: For information on controlling biological growth, see KODAK Publication No. CIS-3, *Biocides for Photographic Solution Tanks and Wash Water*, available at **www.kodak.com/go/photochemicals**.

EFFLUENT DISPOSAL

Effluent from processing labs that use KODAK FLEXICOLOR and EKTACOLOR Chemicals consists of developer, bleach, desilvered bleach-fix, fixer, and stabilizer solutions and/or wash water. This effluent is compatible with and can be effectively treated by a municipal secondary waste-water treatment plant.

Photographic effluent is considered an industrial waste discharge. Most municipalities require a permit to discharge industrial waste to a municipal sewer system. After efficient silver recovery, the effluent from a minilab using Processes C-41, C-41B, C-41RA, and RA-4 has such waste characteristics.

Effluent from processes that use FLEXICOLOR and EKTACOLOR Chemicals will also contain concentrations of ammonia, iron, sulfates, developing agents, and chemicals that have an oxygen demand (BOD, COD). The concentrations of these chemicals will depend on factors such as replenishment and wash rates, type of processor, efficiency of squeegees, chemical regeneration, treatment methods, and the co-mingling of effluent with other processing effluents and non-processing waste water. To characterize waste from your processing operation, it is best to have the effluent sampled by an analytical laboratory according to the method required by local discharge codes.

Material Safety Data Sheets

For more information on the chemical components of the processing chemicals that you use, see the Material Safety Data Sheets. To request MSDSs for Kodak chemicals, you can obtain them online at **www.kodak.com/go/msds.**

Reducing Processing Effluent

Keep the discharge of photographic chemicals as low as possible by using efficient squeegees and the correct replenishment rates. Avoid making batch discharges, such as tank dumps. If your permit allows, discharge large amounts of working-strength solutions by adjusting the pH and then releasing them slowly into the sewer along with your normal non-processing effluent. To adjust the pH, combine high-pH solution (developer) with low-pH solutions (bleach, desilvered bleach-fix, and desilvered fixer) to neutralize the pH.

Consider silver recovery as part of your normal processing operation. For more information on silver recovery, see KODAK Publication No. J-208, *Introducing the "Silver Management" Series.* For more information on silver recovery from Process RA-4, see "Silver Recovery" on page 1-10.

Other Effluent Disposal Methods

Although most labs discahrge their effluent to a municipal waste-water treatment plant, sewer-use discharge restrictions or lack of access to a treatment plant may require some labs to use an off-site disposal (haulaway) service.

Septic tank systems do not have the ability to treat minilab processing effluents properly. Discharging to such a system typically requires permits from state and local authorities. Kodak does not recommend this disposal method.

SILVER RECOVERY

Silver is a seasoning product of processing photographic films and papers. Sewer codes may limit the concentration of silver in effluent that may be discharged. To reduce the amount of silver in the effluent, you can desilver used fixer, bleach-fix, stabilizer, and rinse solutions with electrolytic silver recovery, metallic replacement silver recovery cartridges, or silver-precipitation methods. The most common type of silver recovery with minilab equipment is the metallic replacement silver recovery cartridges. For further information on using these cartridges, see KODAK Publication J-200, *KODAK Chemical Recovery Cartridges* at **www.kodak.com/go/kes**.

SOLID WASTE DISPOSAL

In the U.S., Kodak has an established recycling program for KODAK One-Time Use Cameras designed to help labs minimize the amount of solid waste they send to landfills.

For more information about this program, visit **www.kodak.com/go/kes**

MORE INFORMATION

For general questions regarding health, safety, disposal of chemicals, or other environmental issues, in the U.S. call the Kodak Information Center at 800-242-2424. In Canada, call 800-465-6325. In other regions, contact Kodak in your country.

For emergency health or safety information call (585) 722-5151. For non-emergency information, go to **www.kodak.com/go/kes for the MSDS**.

For questions concerning the safe transportation of Kodak products, call Kodak Transportation Services at 585-722-2400, between 8 a.m. and 5 p.m. (Eastern time).

The products and services described in this publication may not be available in all countries. In countries outside the U.S., contact your local Kodak representative, or your usual supplier of Kodak products. For more information, visit the Kodak website at **www.kodak.com/go/photochemicals**.

Revised 8-11

USING KODAK CHEMICALS IN MINILABS
KODAK Publication No. Z-100-1

Film & Photofinishing Systems Group
EASTMAN KODAK COMPANY • ROCHESTER, NY 14650

Kodak

2 PROCESSING CYCLES FOR KODAK CHEMICALS

KODAK Chemicals are designed to offer you choices to get the best results from your minilab under your processing conditions. From the processing cycles described in this publication, you should be able to select a film processing cycle and a paper processing cycle that are right for your equipment and conditions. Each cycle lists the best chemicals for you to use.

This section describes these process variables:

- Time and temperature
- Replenishment rates
- Agitation
- Filtration
- Drying

It also includes special procedures for adjusting your paper process for periodic low-volume situations.

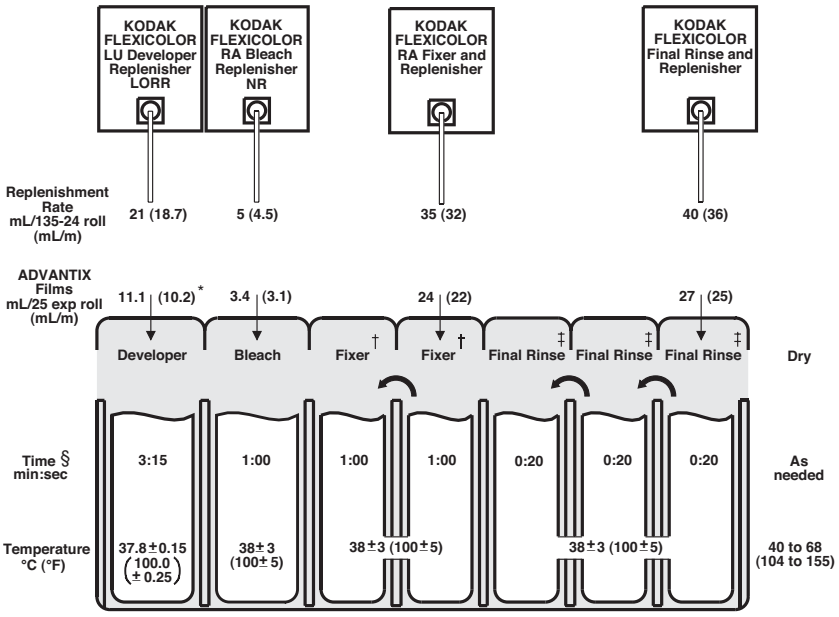
FILM PROCESSING CYCLES

There are four basic variations of Process C-41 for processing Kodak color negative films in minilabs. Three are described here. If you are using KODAK SM Chemicals, see KODAK Publication No. Z-101, *Using KODAK SM Chemicals in SM Minilabs*. You can use each of these process cycles in minilabs that operate with or without wash water. The descriptions of the three cycles will help you decide which matches your particular processor and processing conditions.

The replenishment rates given for each cycle are for a typical mix of Kodak color negative films. Use these rates as starting points; adjust them as required according to your control-plot results.

Process C-41RA Cycle

Process C-41RA has a shorter total process time than Process C-41 or Process C-41B. This process cycle is the one most commonly used in minilab film processing equipment. To use Process C-41RA, the minilab must be capable of providing the higher fixer and stabilizer agitation required (direct-impingement agitation or high turbulation). You must use KODAK FLEXICOLOR RA Bleach Replenisher NR and FLEXICOLOR RA Fixer and Replenisher for Process C-41RA. Although it was designed to be a "washless" cycle, you can use it with a final wash.



F002_0928HC

* These rates are averages based on an estimated film-speed mix in 25-exposure rolls of KODAK ADVANTIX Films.

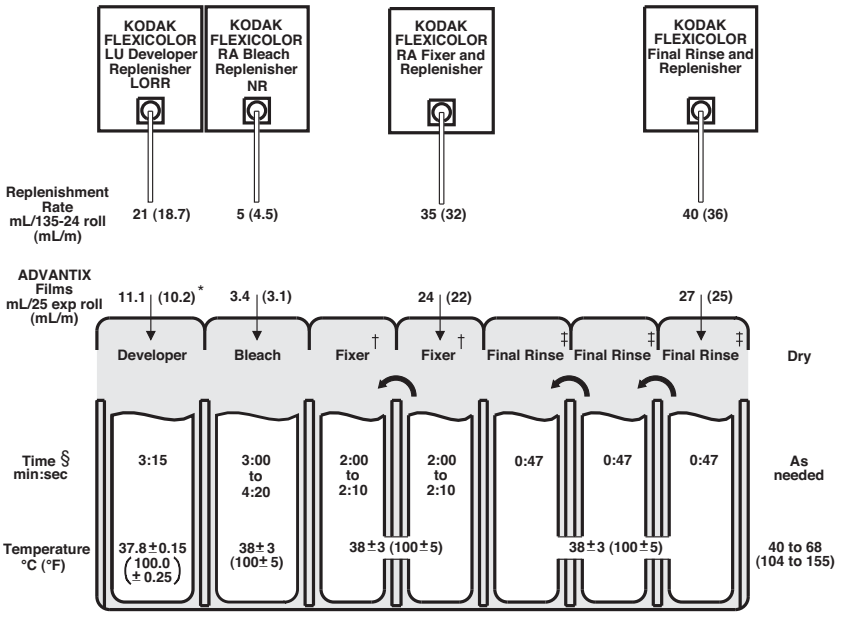
† Use two countercurrent-flow fixer tanks with equal times in both tanks (1:00 in each tank). Your equipment must provide the higher agitation required for this solution.

‡ Use three countercurrent-flow final rinse tanks with equal times in all tanks (0:20). Your equipment must provide the higher agitation required for this solution. Replenish the third final rinse tank at 40 mL/135-24 roll (36 mL/m). For minilabs with a final wash after the fixer, use a wash time of 1:40 and reduce the final rinse time to 40 seconds. Use a wash rate of 1250 mL/135-24 roll (1080 mL/m) for a two-stage countercurrent-flow wash. Double this rate for a single-stage wash. Use a final rinse replenishment rate of 33 mL/135-24 roll.

§ Immersion time plus crossover time to the next tank. Bleach, fixer, and final rinse times are minimums; longer times are acceptable.

Process C-41B Cycle

The primary feature of this processing cycle is that the cycle time is reduced from the standard Process C-41. It eliminates both washes and reduces the fixer time. Originally the process used a final wash, but the most common version in use today is the "washless" cycle. This process cycle is typically used in older minilab film processors.



F002_0927HC

* These rates are averages based on an estimated film-speed mix in 25-exposure rolls of KODAK ADVANTIX Films.

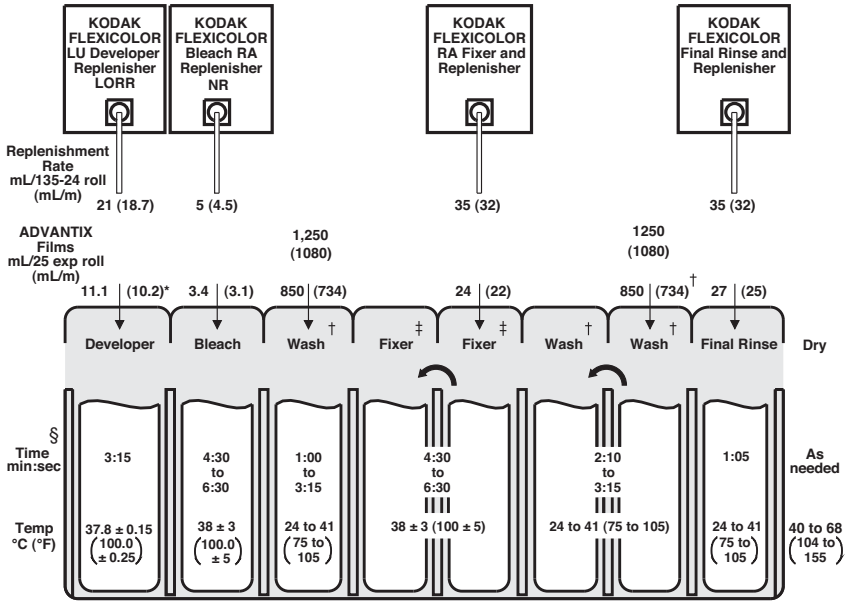
† Use two countercurrent-flow fixer tanks with equal times in both tanks.

‡ If your minilab uses a final wash, also install the final wash between the fixer and final rinse; use two tanks in a counter-current flow configuration with a wash time of 1:40. Reduce the final rinse time to 40 seconds, and use a replenishment rate of 35 mL/135-24 roll (32 mL/m). Use a wash-flow rate of 1250 mL/135-25 roll (1080 mL/m) for a two-stage countercurrent. Double this rate for a single-stage wash.

§ Immersion time plus crossover time to the next tank. Bleach, fixer, and final rinse times are minimums; longer times are acceptable.

Process C-41 Cycle

This process cycle is used in older minilabs. It is most commonly used with wash water. If you want to use this cycle in a "washless" mode, see the second footnote.



F002_0964HC

* These rates are averages based on an estimated film-speed mix in 25-exposure rolls of KODAK ADVANTIX Films.

† Use a two-stage countercurrent-flow wash. For a single-stage wash, double the replenishment rate. If your minilab uses a final rinse step instead of a final wash, eliminate both washes. Use three countercurrent-flow final rinse tanks with a minimum final rinse time of 2:20 (0:47 in each tank). Use a final rinse temperature of 38 ±3°C (100 ±5°F) and a replenishment rate of 40 mL/135-24 roll (36 mL/m).

‡ Use two countercurrent-flow fixer tanks with equal times in both tanks (2:10 to 3:15).

§ Immersion time plus crossover time to the next tank. Bleach, fixer, and final rinse times are minimums; longer times are acceptable.

Other Cycle Information

Processing Times—Times include immersion time plus crossover time to the next tank. Times given are the minimum times for bleach, fixer, and stabilizer solutions; longer times are acceptable in these solutions.

Replenishment Rates—The replenishment rates given are starting-point recommendations for a typical mix of Kodak color negative films.

Developer—If needed, adjust the developer replenishment rate according to your control plots. Your developer replenishment rate depends on these factors:

- type of processor
- amount of the various types of film processed
- film exposure
- other variables of the processing system

Bleach—To maintain chemical concentrations and pH level, the bleach replenishment rate must be high enough to compensate for developer carryover into the bleach. The replenishment rate given is for typical carryover rates. If the carryover rate is higher, retained silver may occur. To offset higher carryover, increase the replenishment rate. See your equipment manual for specifications and adjustments for squeegees or squeegee rollers.

Bleach Aeration—The bleach requires oxygen to return the exhausted bleaching agent to a usable form. Aeration provides oxygen by pumping air bubbles through the bleach. Insufficient aeration can cause leuco-cyan dye and retained-silver problems, particularly with diluted or underreplenished bleach. Too much aeration can cause the bleach to foam or splash. This can contaminate other solutions or cause staining that can increase D-min densities.

Final Rinse—Use KODAK FLEXICOLOR Final Rinse and Replenisher in all types of minilabs. Final Rinse contains wetting agents that provide optimum performance in uniform drying and reducing drying marks. Final Rinse contains no stabilizing agent for safer handling and workplace.

Wash Rates—If your minilab uses a wash step, adjust the flow rate for the maximum film load and then operate at this rate. Do not use average rates. If your minilab has a wash between the bleach and fixer, you can save water and energy by supplying the wash with the overflow from the final wash.

Filtration—Small amounts of insoluble material in the water and solutions can stick to the film and minilab tank walls and rollers. This dirt can damage film. Install filters recommended by the manufacturer of your minilab to remove these materials. Usually, filters with a porosity of 10 to 30 microns are effective for solutions and wash water, and filters with a porosity of 15 microns are effective for incoming water supplies. You can use the following filter materials with processes that use FLEXICOLOR Chemicals:

- bleached cotton
- cellulose with phenolic resin binder
- fiber glass with phenolic resin binder
- polypropylene
- spun polypropylene
- viscose-activated carbon
- viscose rayon with phenolic-resin binder (**do not** use in the developer)
- activated carbon

Polypropylene is the most acceptable filter-core material and one of the least expensive. This material has no photographic effect, but the surfactants used to produce the polypropylene yarns may have an effect on your process. Therefore, monitor your process carefully when you first change filters. Replace filters regularly as part of routine maintenance.

Drying—Keep the film-drying area clean and free of dirt. If the dryer has a filter, check it regularly. Ideally, the drying temperature should not exceed 68°C (155°F). If the film has excessive curl, the ambient conditions are too dry; increase the relative humidity.

PAPER PROCESSING CYCLES

KODAK EKTACOLOR PRIME LORR Chemicals for Process RA-4 are designed for short process times, stable performance, and low replenishment rates.

These three KODAK Chemical products will be the best choice for most minilabs:

KODAK EKTACOLOR PRIME SP Developer Replenisher LORR

KODAK EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR

KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR

EKTACOLOR PRIME LORR Chemicals are recommended for all minilabs with medium to high production volumes. The lower replenishment rates mean that waste-solution volume, packaging waste, and the need for solution mixing are all minimized. EKTACOLOR PRIME LORR Chemicals are supplied as a single-part concentrates for easy mixing.

For minilabs operating in low utilization conditions, we recommend using EKTACOLOR RA Developer Replenisher RT and EKTACOLOR RA Bleach-Fix and Replenisher.

Choosing which chemicals to use in your minilab is simple. You will need only two pieces of information:

1. Volume of the developer tank
2. Number of prints processed in an average day

If the developer tank volume is relatively large and the number of prints per average day is relatively low, your processor is operating for a significant amount of time without sufficient replenishment of fresh chemicals. This can lead to oxidation of the solutions and considerable evaporation from the tank. Both conditions can adversely affect print quality. A cycle for processors with very low production volumes is given on page 2-8. If volumes are low only periodically, you can follow the procedure on page 2-9.

In the table below, find the point that matches your developer tank volume and the number of prints per day. You can them determine by the color coding which developer choice is best for your processor.

Number of 4 x 6-inch (10.2 x 15.2 cm) Prints per Day

Tank Volume (Litres)	125	250	375	500	750	1000	1250	1875	2500
5									
10									
15		■							
20			■						
25			■	■					
30				■					
40					■				
50					■				

Use EKTACOLOR PRIME SP Developer Replenisher LORR

■ Periods of low utilization may require slight increase in replenishment rate.

Use EKTACOLOR RA Developer Replenisher RT

If the table indicates that the number of prints per tank size falls within the "green zone" of normal to mid-utilization, use the following chemicals:

- KODAK EKTACOLOR PRIME SP Developer Replenisher LORR
- KODAK EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR
- KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR

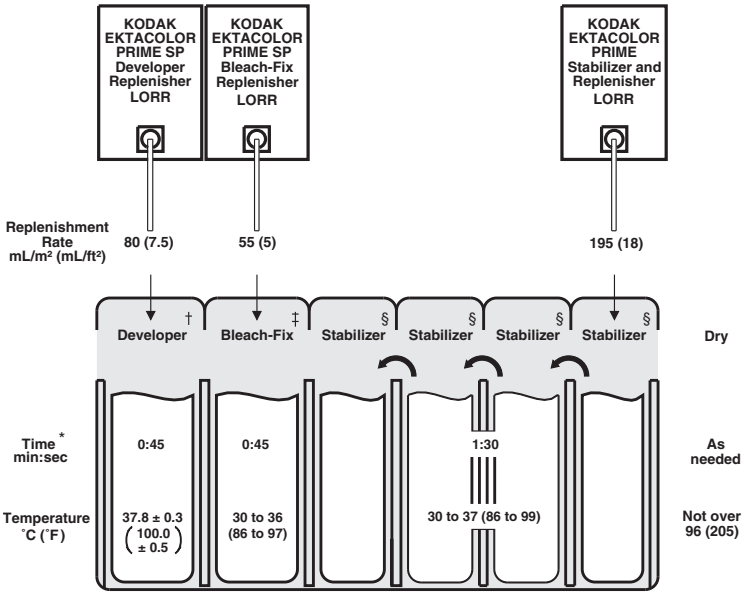
If the table indicates that the number of prints per tank size falls within the "red zone" of low utilization, then use the following chemicals:

- KODAK EKTACOLOR Developer Replenisher RT
- KODAK EKTACOLOR Bleach-Fix and Replenisher
- KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR

Process RA-4 Cycles

The Process RA-4 cycles are standard cycles for processing KODAK EDGE and ROYAL Papers. Use the chemical choices determined from the chart on page 2-6.

Process Cycle for KODAK EKTACOLOR PRIME LORR Chemicals



F002_0931HC

* Immersion time plus crossover time to the next tank. For best results, use the recommended times with crossover times of 6 seconds or less.

† Check the developer temperature frequently with an accurate thermometer. Recirculate and filter. Use squeegees at tank exit.

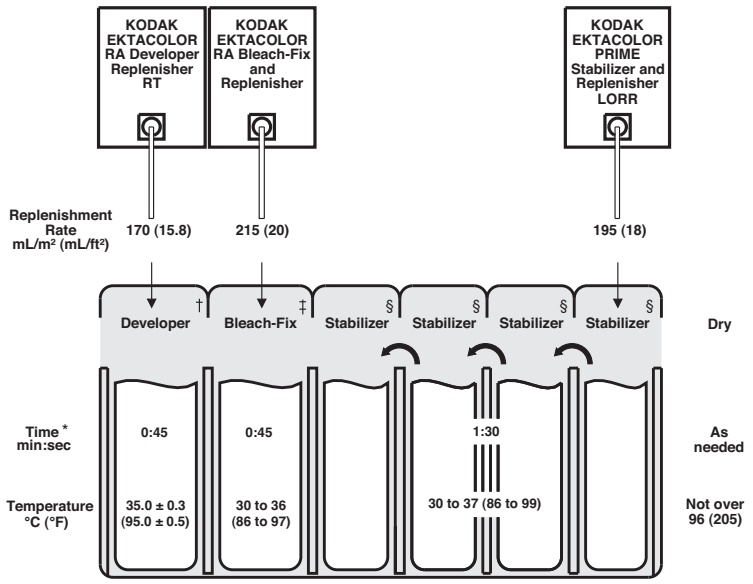
‡ Recirculate and filter. Use squeegees at tank exit.

§ Recirculate and filter. Four countercurrent-flow tanks. For three countercurrent-flow tanks, use a rate of 390 mL/m2 (36 m/ft2); for two countercurrent-flow tanks, use a rate of 780 mL/m2 (72 mL/ft2). If your minilab uses a countercurrent-flow wash instead of a stabilizer, use a wash-water temperature of 30 to 40°C (86 to 104°F). For wash times of 1:30 or longer, the wash-flow rate should be between 2160 and 10,800 mL/m2 (200 and 1000 mL/ft2). The actual rate depends on the number of tanks; see Wash Rates on page 9. Plumb wash tanks for countercurrent flow.

Note: The starting-point replenishment rates are for KODAK EDGE and ROYAL Digital Papers.

For KODAK PROFESSIONAL SUPRA ENDURA VC Digital Paper, increase the replenishment rate for PRIME SP Developer Replenisher LORR by 5 percent to 84 mL/m^2 (7.8 mL/ft^2).

Process Cycle for Low Production Volumes



F002_0932HC

* Immersion time plus crossover time to the next tank. For best results, use the recommended times with crossover times of 6 seconds or less.
† Check the developer temperature frequently with an accurate thermometer. Recirculate and filter. Use squeegees at tank exit.
‡ Recirculate and filter. Use squeegees at tank exit.
§ Recirculate and filter. Four countercurrent-flow tanks. For three countercurrent-flow tanks, use a rate of 390 mL/m2 (36 m/ft2); for two countercurrent-flow tanks, use a rate of 780 mL/m2 (72 mL/ft2). If your minilab uses a countercurrent-flow wash instead of a stabilizer, use a wash-water temperature of 30 to 40°C (86 to 104°F). For wash times of 1:30 or longer, the wash-flow rate should be between 2160 and 10,800 mL/m2 (200 and 1000 mL/ft2). The actual rate depends on the number of tanks; see "Wash Rates" on page 2-9. Plumb wash tanks for countercurrent flow.

Other Cycle Information

Processing Times—Times include immersion time plus crossover time to the next tank. For best results, use the recommended times with crossover times of 6 seconds or less.

Note: For minilabs with process times shorter than 45 seconds, in the developer and bleach-fix steps, it is acceptable to process KODAK EDGE, ROYAL Digital, ROYAL Luminous, and Photo Book Paper at these shorter cycle times. For further information refer to www.kodak.com/go/photochemicals and click on the Technical Publications tab. Kodak does not recommend processing KODAK PROFESSIONAL Papers such as SUPRA ENDURA VC Digital, ULTRA ENDURA, ULTRA ENDURA HD, or ENDURA Metallic VC Papers in developer cycle times shorter than 45 seconds due to potential decreases in the D-max areas of the image.

Replenishment Rates—The specified replenishment rates are starting-point recommendations. Actual rates depend on the type of processor, the amount of paper processed, and other variables of the processing system. The rates are given in millilitres per square metre and millilitres per square foot. To convert the rate to millilitres per minute, multiply the rate in mL/m^2 by the processor speed in m^2/min (or mL/ft^2 by the processor speed in ft^2/min).

Developer—If necessary, adjust the replenishment rate to optimize your process control.

Bleach-Fix—The bleach-fix replenishment rates assume minimum developer carryover. If carryover is greater than normal, increase the bleach-fix replenishment rate to maintain the bleach-fix chemical balance and pH level. Otherwise, problems such as retained silver may occur. See your equipment manual for specifications and adjustments for squeegees or squeegee rollers.

Stabilizer—For four countercurrent-flow tanks. For three countercurrent-flow tanks, use a rate twice the starting-point recommendation; for two countercurrent-flow tanks, use a rate four times the starting-point recommendation, e.g., for EKTACOLOR PRIME Stabilizer and Replenisher LORR, the rate for two tanks would be 780 mL/m^2 (72 mL/ft^2).

Wash Rates—If your minilab processor uses a conventional water wash rather than a stabilizer solution, the flow rate of the final wash depends on the number of wash tanks and the amount of paper processed. Some processors automatically adjust the wash rate for the size and amount of paper processed. If the minilab does not automatically adjust the wash rate, set the rate for the maximum paper width.

Wash Rates for Process RA-4

Number of Final Wash Tanks	Final Wash Rate mL/m² (mL/ft²)
1	See the note below
2	6,460 to 10,800 (600 to 1000)
3	4,300 to 10,800 (400 to 1000)
4	2,150 to 10,800 (200 to 1000)

Note: If your minilab has a single wash tank, use a wash rate of at least 10,800 mL/m² (1000 mL/ft²). You may need to make other equipment modifications to minimize the effect of bleach-fix carryover because this rate may provide only a marginal safety factor.

Agitation—The recirculation rates for the developer and bleach-fix should be 0.50 to 0.75 tank volume/minute. The recirculation rate for the stabilizer should be 0.67 to 1.0 tank volume/minute. With multiple tanks, the recirculation rate should be the same in each tank. Low-volume and slow-transport-speed processors may require higher agitation to maintain process activity.

Good agitation is important during the first few seconds of the developer and bleach-fix steps. If initial agitation is poor in the developer, development may be uneven. Poor initial agitation in the bleach-fix may not stop development uniformly, which can cause magenta streaks and non-uniformity. This problem can be aggravated by excessive developer carryover into the bleach-fix.

Filtration—Processing solutions and wash water may contain some insoluble materials. If you don't filter out these materials, they can stick to the paper, tank walls, and rollers, and possibly damage the paper. Use the filters designed for your processor or those recommended by the manufacturer. Usually, filters with a porosity of 10 to 30 microns are effective for solutions and wash water. For incoming water supplies, use a filter with a porosity of 15 microns.

You can use the following filter materials with processes that use EKTACOLOR Chemicals:

- bleached cotton
- cellulose with phenolic-resin binder
- fiberglass with phenolic-resin binder
- polypropylene
- spun polypropylene
- viscose rayon with phenolic-resin binder (use in the developer)
- activated carbon

Polypropylene is the most acceptable filter-core material and one of the least expensive. This material has no photographic effect, but the surfactants used to produce the polypropylene yarns may have an effect on your process. Therefore, monitor your process carefully when you first change filters. Replace filters weekly for developers and every two weeks for other solutions.

Drying—The maximum drying temperature for KODAK EDGE and ROYAL Papers is 96°C (205°F).

OPERATING MINILABS IN PERIODS OF LOW PRODUCTION VOLUMES

The Kodak chemicals used in minilab processors are very robust and are designed to cover a wide range of processor utilization from high to low. They will remain stable when processors are well maintained and production volumes do not fall to very low levels.

However, a lab's business cycle will sometimes include periods when low processing volumes can cause the quality of the working tank solutions to degrade. During these periods of low utilization, special maintenance procedures and specific paper-processing chemicals will keep the working tank solutions in the processor performing adequately.

The following paragraphs describe film and paper processor options and guidelines for use during periods of low utilization.

Process C-41

If your minilab film processor is operating in low utilization conditions, extra care and maintenance is needed to keep the tank solutions working properly. Low utilization can affect the performance of all processing solutions, especially the developer, which is the most perishable tank solution. To determine if your film processor is operating in low utilization, use the table below, which compares the of your developer tank to the number of rolls processed each week.

KODAK FLEXICOLOR LU Developer Replenisher LORR

Films per Week	Tank Volume in Litres									
	3	5	8	10	15	20	25	30	40	50
300										
200										
150										
100										
75										
50										
40										
30										
20										

	Normal utilization, no special procedures required
	Borderline low utilization, special procedures may be required.
	Low utilization, special procedures required

If the number of rolls processed compared to the tank size falls within the "Green Zone" in the table, then the processor is operating with normal utilization and no special maintenance procedures are required.

If the number of rolls processed is in the "RedZone," this indicates your processor is operating under low utilization conditions. Use the following recommendations to help reduce the effects of low utilization:

- Top off all tank solutions with water at processor startup. If your processor has an auto-top-off system, use it to top off with water at start-up of the processor, but not at shutdown.
- Add a floating lid, or use material to act as a floating lid, in the developer replenisher tank of the processor.
- Use a smaller size of developer replenisher to mix the solution, and mix it more frequently. For example, if you are using the 10-litre size of FLEXICOLOR LU Developer Replenisher LORR, switch to the 5-litre size (CAT No. 823 1672).
- Replace the final rinse tank solutions at least once a month (more often if necessary) to keep them clean and free of biological growth.

Optional Procedure:

- Increase the replenishment rates for all solutions by 10 to 15 percent; do not increase them by more than this percentage.
- When a processor is operating with extremely low utilization, replace approximately 5 percent of the total volume of the developer tank solution each day at startup. Use properly mixed developer working tank solution (water, starter, and developer replenisher). For convenience, keep a supply of developer working tank solution mixed and stored in a sealed container for this purpose.

Process RA-4

As a general guideline, use the table on page 2-6 to determine if the processor is operating in low utilization conditions. If your processor is operating in low utilization, and this condition is persistent, we recommend that you use KODAK EKTACOLOR Developer Replenisher RT and KODAK EKTACOLOR RA Bleach-Fix and Replenisher with the process cycle described on page 2-8. These chemicals are designed for use at lower temperatures and with higher replenishment rates to reduce the effects of low utillization.

When processor utilization is very low, tank solutions can be prone to the following problems:

- D-min, especially the yellow D-min, can increase by as much as 6 density points.
- The LD (speed) process-control parameter can fall below aim by as much as 10 density points.

Following these recommendations will help reduce the effects of very low utilization:

- Top off all tank solutions with water at startup of the processor and at each shift change.
- Replace the stabilizer tank solutions at least once a month, or as necessary, to keep them clean and free of biological growth.
- The increased yellow D-min described above is most commonly caused by the stabilizer. Replacing the stabilizer tank solution will usually correct the problem. In many cases, changing only the first tank or the first two tanks will be sufficient. If high yellow D-min persists, increase the replenishment rate for EKTACOLOR PRIME Stabilizer and Replenisher LORR from 18 mL/ft^2 (195 mL/m^2) to 23 mL/ft^2 (248 mL/m^2) until your processing volume increases.
- If the LD speed falls outside the lower action limit, increase the developer replenishment rate by 10 to 20 percent. Also increase the bleach-fix rate by 10 to 20 percent as well.

Revised 8-11

Processing Cycles for KODAK Chemicals
KODAK Publication No. Z-100-2

Film & Photofinishing Systems Group
EASTMAN KODAK COMPANY • ROCHESTER, NY 14650

Kodak

3 PROCESS MONITORING

Process monitoring is the routine gathering and recording of information on all aspects of your photographic process to manange 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

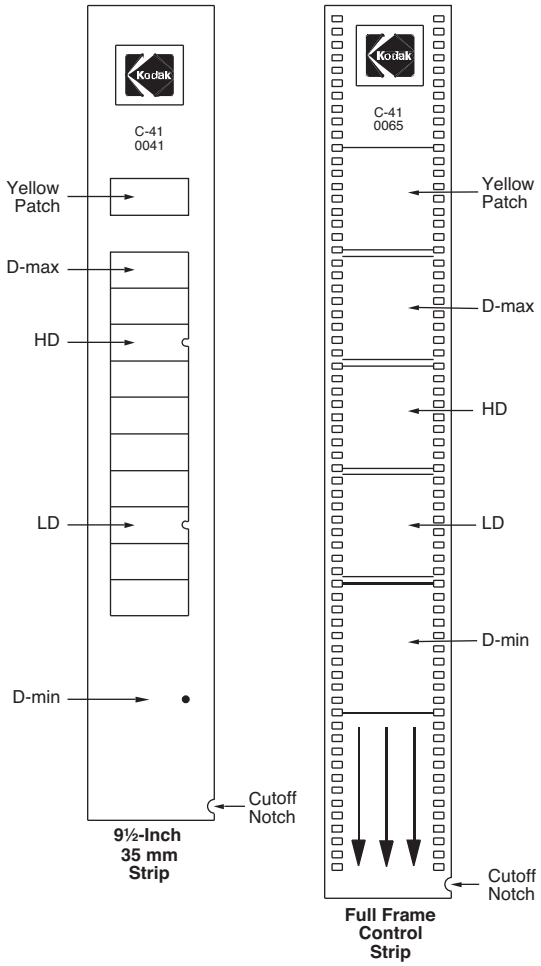
Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits	Color Balance Spread Limit
D-min	+ 0.03	+ 0.05	+ 0.07	NA
LD	±0.04	±0.08	±0.10	NA
HD - LD	±0.03	±0.08	±0.10	0.09
$D\text{-max}_B$ - Y_B	±0.07	+ 0.10	+ 0.12	NA

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.

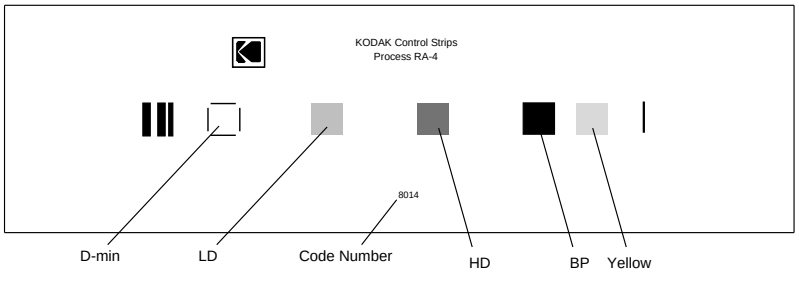
STORING, HANDLING, AND PROCESSING CONTROL STRIPS

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

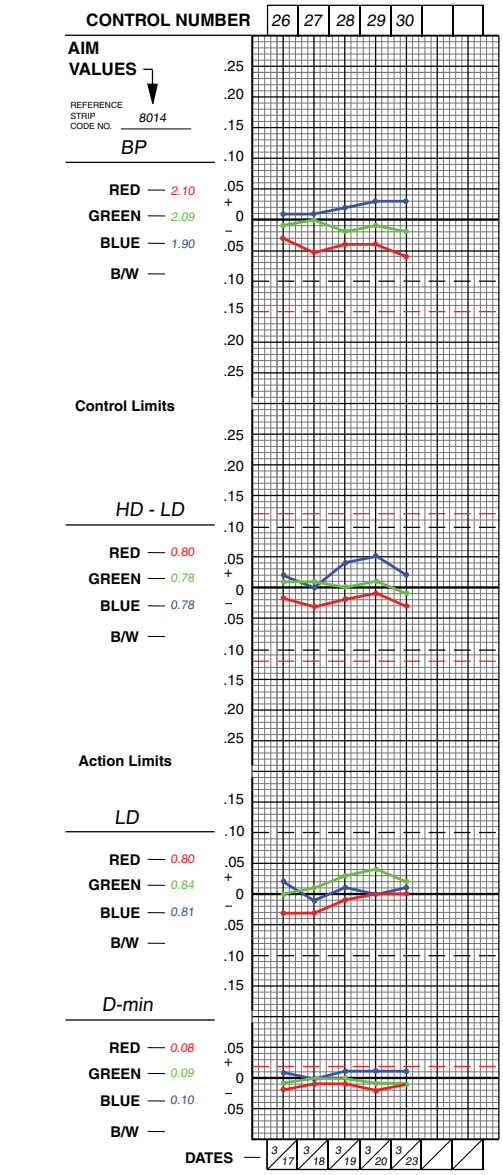
Each time you process a control strip, position it in the same location in your processor. Process a control strip—

- 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.



F002_0817EC

PROCESS MACHINE RA-4 Color Print Processor

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.

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-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.

Revised 7-11

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

Film & Photofinishing Systems Group
EASTMAN KODAK COMPANY • ROCHESTER, NY 14650

Kodak

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

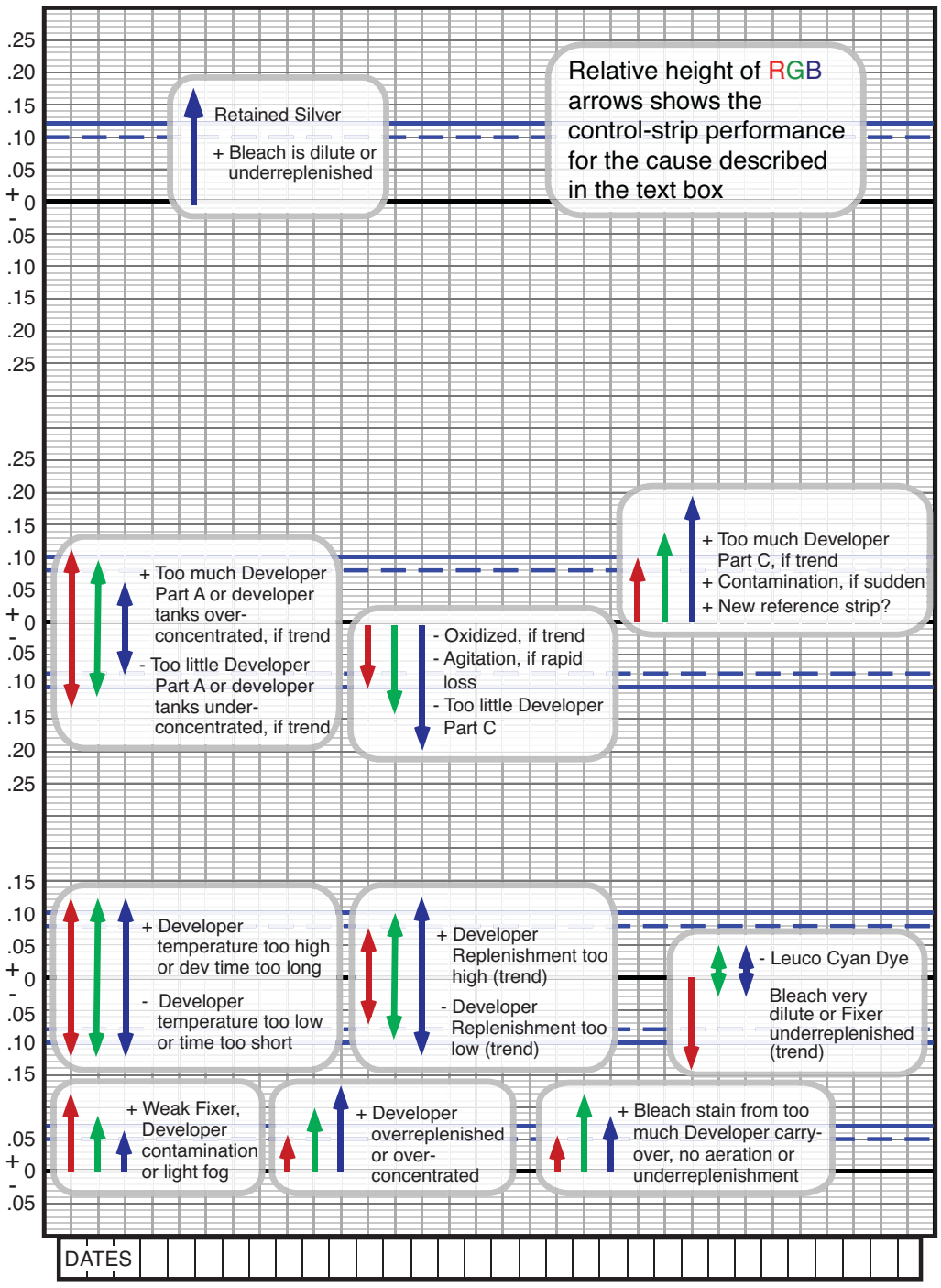
LD
(+/- 0.08 & 0.10)
Developer Activity
- time/temp
- replenishment

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

Bleach,
- stain

Fixer Activity
- retained silver halide

F002_1244EC



PROCESS: _____

MACHINE: _____

Kodak

Eastman Kodak Company, Rochester, NY 14650

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.

Process RA-4
Visual Process Control Guide

Yellow Patch
- (Visual check only)

Bleach-Fix Activity
- retained silver

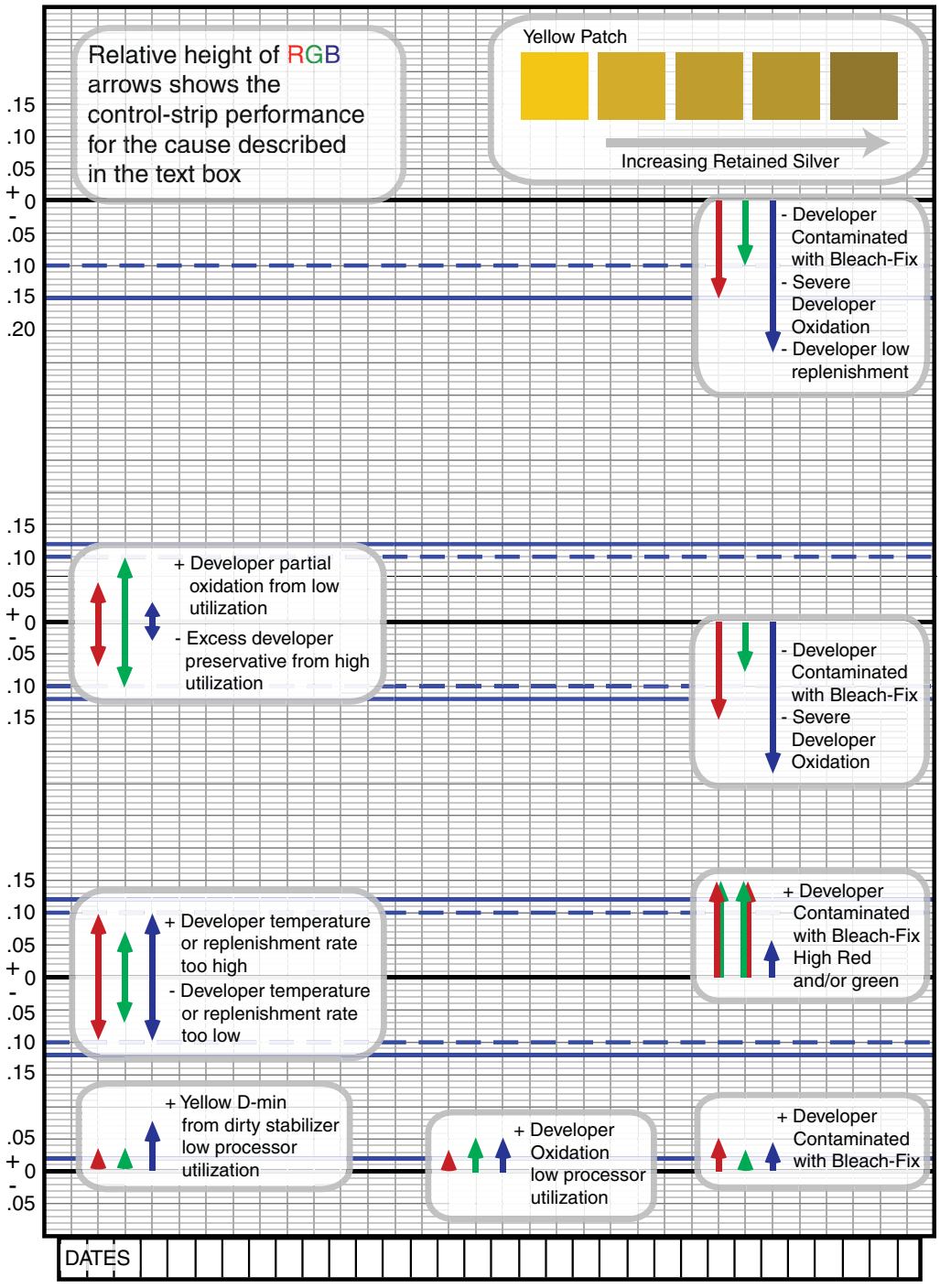
Black Patch
(- 0.10 & - 0.15)
Developer Activity
- severe oxidation
- contamination

HD-LD
(+/- 0.10 & 0.12)
Developer Activity
- high and low utilization

LD
(+/- 0.10 & 0.12)
Developer Activity
- time/temp
- replenishment
- low utilization

D-min
(+ 0.02)
Developer,
- BF contamination
- low utilization

Stabilizer
- low utilization



PROCESS:_____

MACHINE: _____

F002_1242EC

Kodak

Eastman Kodak Company, Rochester, NY 14650

PROCESS RA-4 CORRECTIVE ACTION AND PRESCRIPTIONS

Yellow Patch

The Yellow Patch monitors the performance of the bleach-fix solution for **retained silver.** There is no plotting of the yellow patch on a control chart, this is meant to be a visual reference only. Compare the yellow patch on a processed control strip with the yellow patch on the reference strip. If the yellow patch appears less saturated in color, or "muddy" compared to the reference, you may have retained silver. A bleach-fix solution that is underreplenished or diluted will not efficiently remove silver in the paper, leaving retained silver in higher density areas. You can confirm retained silver confirm by the following test:

1. Take your processed control strip and reprocess it back through the the processor in order to rebleach-fix the control strip, or use mixed PRIME SP Bleach-Fix Replenisher LORR and soak strip for 3 minutes, then wash for 3 minutes under running water.
2. Compare the Yellow Patch again on the reprocessed control strip to the yellow patch on the reference strip, if this has improved the yellow patch on the reprocessed strip, then you have confirmed a retained silver problem.

Prescription

For a severe retained silver problems replace all of the bleach-fix tank. If there is any precipitate found in the bleach-fix tank (sulfurization), replace all of the bleach-fix tank. For minor retained silver problems, use this prescription:

- For PRIME SP Bleach-Fix LORR, or regular Bleach-Fix, replace 25% of the bleach-fix tank with an equivalent amount of mixed replenisher.

D-max (Black Patch)

Monitors the performance of the developer for activity and contamination. There is no upper control limit for Black Patch. If the Black Patch plots are low, then it could be an indication of low developer activity due to under replenishment or oxidation. If the Blue Black patch is very low, out-of-control, separated from the red and green plots, it could be a sign of extremely low developer activity, short developer time, severe oxidation or a contaminated developer. See Prescriptions listed under the **LD** parameter.

HD - LD (Contrast)

The HD-LD is monitor for developer activity. Usually this is a very steady plot parameter that is unresponsive to most process problems. However, it can help monitor problems due to **high** or **low utilization**, severe developer **oxidation**, **or contamination**.

- For HD-LD plots that are only marginally high, over the action limit or slightly over the control limit, this may be due to using PRIME SP Developer Replenisher LORR in a very low utilization conditions. Switch to EKTACOLOR Developer Replenisher RT.
- For HD-LD plots that are only marginally low, under the action limit or slightly under the control limit, this may be due to using EKTACOLOR Developer Replenisher RT in a mid to high utilization conditions. Switch to PRIME SP Developer Replenisher LORR.
- For HD-LD plots that are very low, with blue being more than 0.16 density units under aim, this may be due to severe developer oxidation or contamination. Dump and clean developer tank, replace with fresh developer tank solution.

LD (Speed)
LD (Speed) monitors developer activity. It is the primary indicator of problems with developer **time, temperature, and replenishment rate**. If the plots are very out-of-control, by more than 0.16 density units over or under aim, dump and replace developer. If the plots are less than 0.16 density, a prescription can be risked.

- For **high LD** plots:

  Temperature too high: Check temperature with an accurate thermometer and make sure it is in specification, adjust if necessary. See Section 2, pages 2-7 and 2-8 for specifications.

  Developer time too long: Test developer time with stopwatch to make sure it is in specification, adjust if necessary. See Section 2, pages 2-7 and 2-8 for specifications.

  Overreplenishment: Remove a volume of developer tank solution equal to 5% of the total tank, replace with an equal amount of a mixed solution containing 9 parts water and 1 part EKTACOLOR Developer Starter. Add to developer tank, let temperature stabilize, and run a control strip. Repeat until in control. Also, verify the developer replenishment rate is set correctly, and calibrate developer replenisher pump. See Section 2, pages 2-7 and 2-8 for replenishment rate specifications.

  Contamination: If the Red and/or Green LD are very high and split from the Blue, then the problem is likely due to a developer contaminated with bleach-fix. The developer must be dumped and replaced with fresh developer tank solution. Make sure the tank is cleaned thoroughly.

- For **low LD** plots:

  Temperature too low: Check temperature with an accurate thermometer and make sure it is in specification, adjust if necessary. See Section 2, pages 2-7 and 2-8 for specifications.

  Developer Time too Short: Test developer time with stopwatch to make sure it is in specification, adjust if necessary. See Section 2, pages 2-7 and 2-8 for specifications.

  Underreplenishment: Remove a volume of developer tank solution equal to 5% of the tank volume. Add mixed developer replenisher to the tank, let temperature stabilize, and run a control strip. Repeat until it is in control.

D-min (Stain)
D-min monitors the performance of the developer and stabilizer. The control limit is plus 0.02 (D-min has no lower limit). The "whiteness" of the paper can be affected by three process conditions:

Stabilizer Condition with Low Utilization—High blue D-min with a yellow appearance on the processed control strip and paper is most commonly caused by the condition of the stabilizer tank solutions when the processor is running at low production volumes.

Prescriptions

- Periodic replacement of the first or second stabilizer tank following the bleach-fix tank may be sufficient. Otherwise, replace the solution in all stabilizer tanks with fresh mixes.
- During periods of low utilization, increase the replenishment rate for EKTACOLOR PRIME Stabilizer and Replenisher LORR from 195 mL/m2 to 248 mL/m2.

Note: See "Operating Minilabs in Period of Low Production Volumes," page 2-10.

Oxidized Developer—High green and blue D-min with a pink or reddish appearance on the processed control strip and paper is most commonly caused by an oxidized developer due to aeration of the tank or low-volume operation.

Prescriptions

- Verify that no air leak into the recirculation system is causing developer oxidation.
- In cases of moderate oxidation, partial replacement of the developer tank volume—at least one-third—may resolve the problem. If the developer is severely oxidized, you must replace the developer tank solution with a fresh mix.

Developer Contamination: A high Red D-min or Blue D-min can indicate a problem with a developer contaminated with bleach-fix. The visual appearance of the D-min of the processed control strip or paper be cyan or yellow. Indications of a contamination developer should also be evident with high plots in LD and low Plots in the Black patch parameter. The developer tank should be rinsed out thoroughly, and replaced with new developer tank solution.

APPENDIX

Simplified Metric Conversion Charts

Because most laboratory measuring devices are calibrated in metric units, you can use the following table to convert U.S. units of volume, length, and weight to metric units. **Do not** use this table to convert from metric to U.S. values. Accuracy of the table is within one percent.

To use the table, find the number you are converting from at the top of the table for numbers from 1 to 9. For numbers greater than nine, find the number you are converting by using a combination of the number at the left side of the table and the number at the top.

Volume, Length, and Weight Conversion

U.S. Gallons to Litres										
gal	0	1	2	3	4	5	6	7	8	9
0	—	3.8	7.6	11.4	15.1	18.9	22.7	26.5	30.3	34.1
10	37.8	41.6	45.4	49.2	53	56.8	60.6	64.4	68.1	71.9
20	75.7	79.5	83.3	87.1	90.8	94.6	98.4	102.2	106	107.8
30	113.6	117.3	121.1	124.9	128.7	132.5	136.3	140.1	143.8	147.6
40	151.4	155.2	159	162.8	166.6	170.3	174.1	177.9	181.7	185.5
U.S. Fluidouncess to Millilitres										
fl oz	0	1	2	3	4	5	6	7	8	9
0	—	29.5	59	89	118	148	177	207	237	265
10	295	325	355	385	415	445	475	500	530	560
20	590	620	650	680	710	740	770	800	830	860
30	890	920	950	980	1006	1035	1065	1094	1124	1153
Inches to Centimetres										
in.	0	1	2	3	4	5	6	7	8	9
0	—	2.5	5.1	7.6	10.2	12.7	15.2	17.8	20.3	22.9
10	25.5	28.0	30.5	33.0	35.5	38.0	40.5	43.0	45.5	48.5
20	51	53	56	58	61	64	66	69	71	74
30	76	79	81	84	86	89	91	94	97	99
Ounces to grams										
oz	0	1	2	3	4	5	6	7	8	9
0	—	28.5	57	85	113	142	170	198	227	255
10	285	310	340	370	395	425	455	480	510	540
20	570	600	620	650	680	710	740	770	790	820
30	850	880	910	940	960	990	1021	1049	1077	1106

You can use the following to convert from metric to U.S. values or from U.S. to metric values. To do this, multiply the metric or U.S. units in column 1 by the number in column 2 (e.g., to convert 450 millilitres to fluidounces, multiply 450 by 0.03382 = 15.22 fluidounces).

Conversion Factors

To Convert	Multiply By
Millilitres to Fluidounces	0.03382
Fluidounces to Millilitres	29.573
Pints to Litres	0.4732
Litres to Pints	2.113
Quarts to Litres	0.9463
Litres to Quarts	1.057
Gallons to Litres	3.785
Litres to Gallons	0.2642

Temperature Conversion

To convert a temperature from one unit of measure to another, use the following table. Find the temperature you are converting from in the "°F or °C" column; if you are converting to degrees Celsius, read the number from the "to °C" column. If you are converting to degrees Fahrenheit, read the number from the "to °F" column.

to °C	°F or °C	to °F
37.78	100	212.0
37.22	99	210.2
36.67	98	208.4
36.11	97	206.6
35.56	96	204.8
35.00	95	203.0
34.44	94	201.2
33.89	93	199.4
33.33	92	197.6
32.78	91	195.8
32.22	90	194.0
31.67	89	192.2
31.11	88	190.4
30.56	87	188.6
30.00	86	186.8
29.44	85	185.0
28.89	84	183.2
28.33	83	181.4
27.78	82	179.6
27.22	81	177.8
26.67	80	176.0
26.11	79	174.2
25.56	78	172.4
25.00	77	170.6
24.44	76	168.8
23.89	75	167.0
23.33	74	165.2
22.78	73	163.4
22.22	72	161.6
21.67	71	159.8
21.11	70	158.0
20.56	69	156.2
20.00	68	154.4
19.44	67	152.6
18.89	66	150.8

to °C	°F or °C	to °F
18.33	65	149.0
17.78	64	147.2
17.22	63	145.4
16.67	62	143.6
16.11	61	141.8
15.56	60	140.0
15.00	59	138.2
14.44	58	136.4
13.89	57	134.6
13.33	56	132.8
12.78	55	131.0
12.22	54	129.2
11.67	53	127.4
11.11	52	125.6
10.56	51	123.8
10.00	50	122.0
9.44	49	120.2
8.89	48	118.4
8.33	47	116.6
7.78	46	114.8
7.22	45	113.0
6.67	44	111.2
6.11	43	109.4
5.56	42	107.6
5.00	41	105.8
4.44	40	104.0
3.89	39	102.2
3.33	38	100.4
2.78	37	98.6
2.22	36	96.8
1.67	35	95.0
1.11	34	93.2
0.56	33	91.4
0.00	32	89.6
-0.56	31	87.8

to °C	°F or °C	to °F
-1.11	30	86.0
-1.67	29	84.2
-2.22	28	82.4
-2.78	27	80.6
-3.33	26	78.8
-3.89	25	77.0
-4.44	24	75.2
-5.00	23	73.4
-5.56	22	71.6
-6.11	21	69.8
-6.67	20	68.0
-7.22	19	66.2
-7.78	18	64.4
-8.33	17	62.6
-8.89	16	60.8
-9.44	15	59.0
-10.00	14	57.2
-10.56	13	55.4
-11.11	12	53.6
-11.67	11	51.8
-12.22	10	50.0
-12.78	9	48.2
-13.33	8	46.4
-13.89	7	44.6
-14.44	6	42.8
-15.00	5	41.0
-15.56	4	39.2
-16.11	3	37.4
-16.67	2	35.6
-17.22	1	33.8
-17.78	0	32.0
-18.33	-1	30.2
-18.89	-2	28.4
-19.44	-3	26.6
-20.00	-4	24.8

For temperatures not shown in the above table, use the following formulas:

1. To convert to degrees Celsius, add 40 to the Fahrenheit temperature. Then divide by 1.8; subtract 40 from the result.
2. To convert to degrees Fahrenheit, add 40 to the Celsius temperature. Then multiply by 1.8; subtract 40 from the result.

Revised 8-11

Using KODAK Chemicals in Minilabs
KODAK Publication No. Z-100-4

Film & Photofinishing Systems Group
EASTMAN KODAK COMPANY • ROCHESTER, NY 14650

Kodak