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.

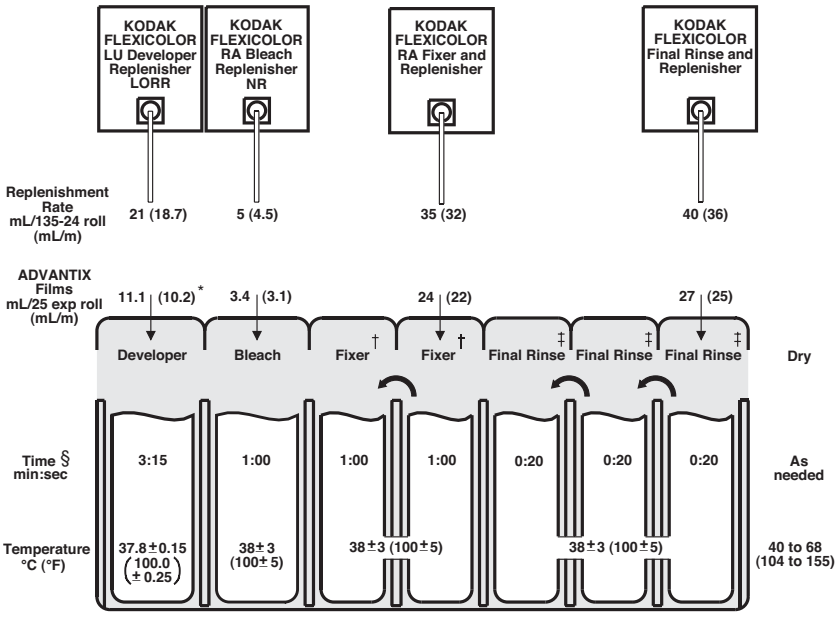
FILM PROCESSING CYCLES

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.



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

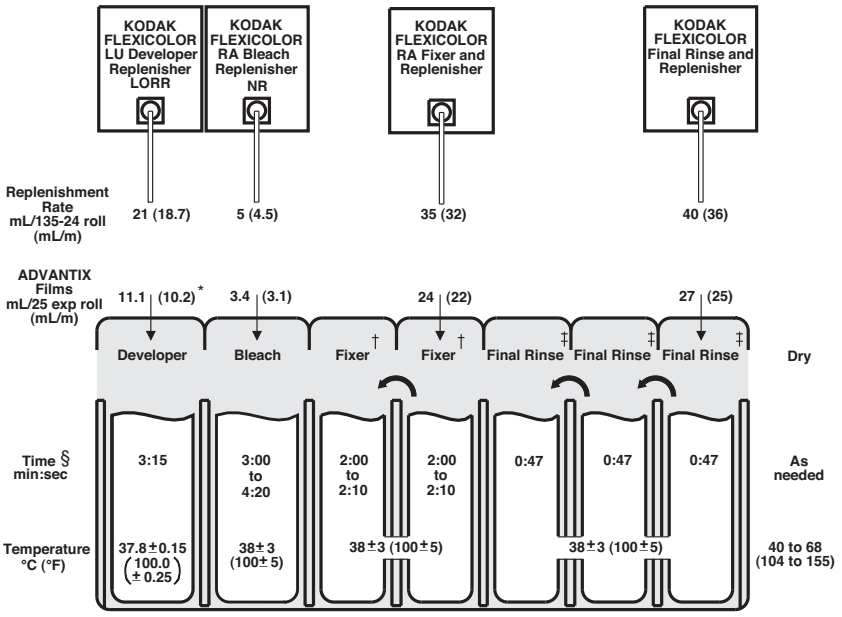
† Use two countercurrent-flow fixer tanks with equal times in both tanks (1:00 in each tank). Your equipment must provide the higher agitation required for this solution.

‡ 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.



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

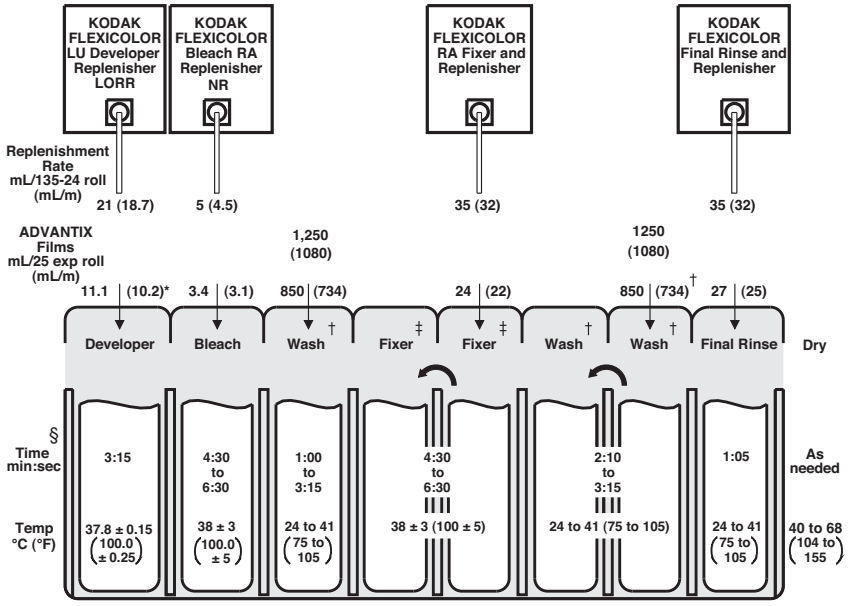
† Use two countercurrent-flow fixer tanks with equal times in both tanks.

‡ 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.



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* 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

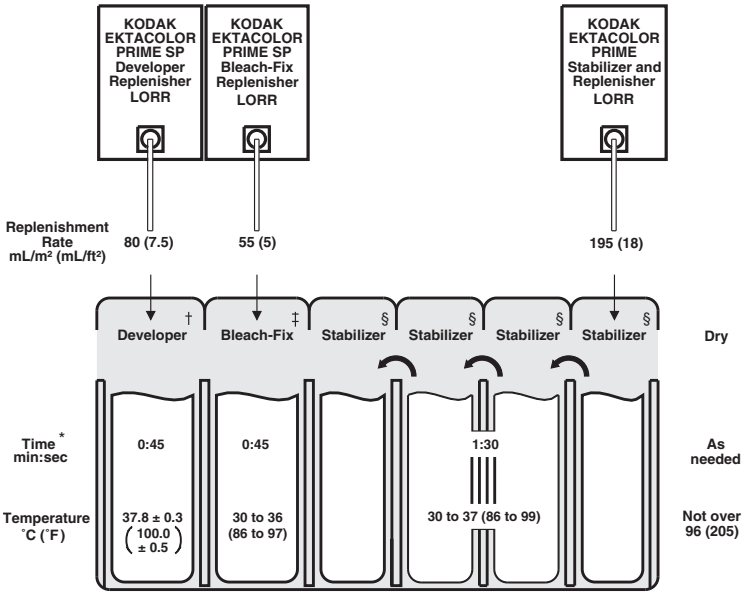
If the table indicates that the number of prints per tank size falls within the "red zone" of low utilization, then use the following chemicals:

- 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



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* 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.

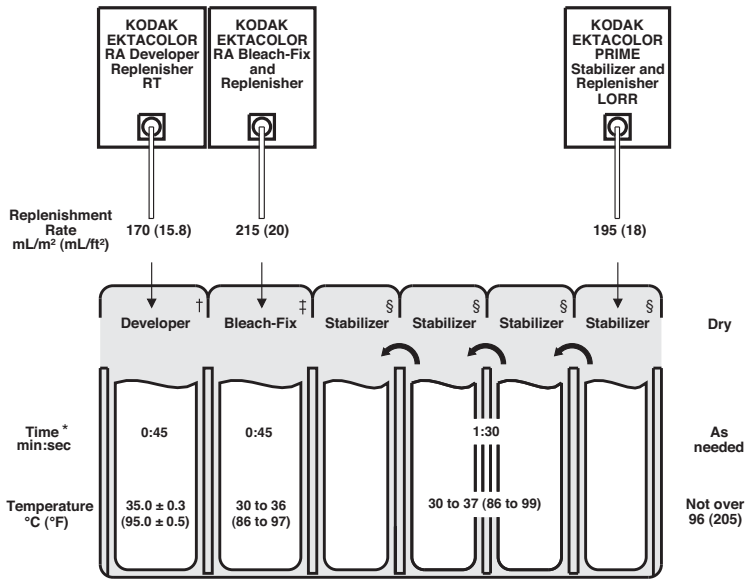
‡ Recirculate and filter. Use squeegees at tank exit.

§ 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



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* 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.

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

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Kodak