

1 KODAK EKTACOLOR Chemicals

KODAK EKTACOLOR Chemicals are designed for processing all Kodak color papers. This section describes the chemicals, lists the available sizes, and tells you how to mix and store them. It also gives simple methods of checking chemical mixes, and tells how to dispose of used chemicals properly and safely.

EKTACOLOR Chemicals can process the following papers and materials:

- KODAK EKTACOLOR EDGE Paper
- KODAK ROYAL Digital Paper
- KODAK ROYAL Luminous Digital Paper
- KODAK Photo Book Paper
- KODAK PROFESSIONAL SUPRA ENDURA VC Digital Paper
- KODAK PROFESSIONAL ULTRA ENDURA Paper
- KODAK PROFESSIONAL ULTRA ENDURA High Definition Paper
- KODAK PROFESSIONAL ENDURA Metallic VC Paper
- KODAK PROFESSIONAL ENDURA Clear Display Material
- KODAK PROFESSIONAL ENDURA Transparency Display Material

Notes:

1. For information on KODAK EKTACOLOR SM Chemicals for Process RA-2SM, see KODAK Publication No. Z-101, *Using KODAK SM Chemicals in SM Minilabs*.
2. For Information on using the KODAK EKTACOLOR Processing Cartridge 111, for use in all models of Fuji Frontiers, and some models of Noritsu Digital Minilab equipment, using Processes CP-48S and CP-49E, see KODAK Publication No. CIS-229, *Using the KODAK EKTACOLOR Processing Cartridge 111 with Digital Minilabs using Processes CP-48S and CP-49E*.
3. For Information on KODAK EKTACOLOR Processing Cartridge 92/110, for use in KODAK PROFESSIONAL RP30 and SRP30 Laser Printers, see KODAK Publication Nos. CIS-239, *Using the KODAK EKTACOLOR Processing Cartridge 92/110, CAT No. 1440775, for Professional Color Papers in KODAK PROFESSIONAL RP30 and SRP30 Laser Printers*, and CIS-280, *Using the KODAK EKTACOLOR Processing Cartridge 92/110, CAT No. 1440775, for Processing KODAK EKTACOLOR EDGE, ROYAL Digital, and KODAK PROFESSIONAL Pro Image II and PROFOTO Color Papers*.

WHY USE KODAK CHEMICALS?

The primary considerations when you choose photographic chemicals are—

- quality of the results the chemicals produce
- availability, reliability, and expertise of the service you receive
- availability of the chemicals
- environmental impact of the chemicals
- chemical cost

In all of these factors, KODAK EKTACOLOR Chemicals are superior or competitive. Low replenishment rates not only lower your chemical costs; they mean less chemical mixing and lower labor costs. They also mean less environmental impact, because the volume of effluent is reduced.

KODAK EKTACOLOR Chemicals are readily available. And when you purchase KODAK Chemicals, you are supported by a reliable network of expertise: Kodak field representatives, the Kodak Information Center, Kodak Service and Support, Kodak Environmental Services, KODALINK Quality Management Software, and many helpful publications and other services.

Choosing the chemicals recommended in this publication ensures that you are using chemicals that provide optimum results with the smallest possible environmental impact.

KODAK EKTACOLOR Chemicals for Process RA-4 offer you these features and benefits:

FEATURES	BENEFITS
• Fast access time	• Quick processing of prints • Fast results from printer tests
• Low replenishment rates	• Less chemical mixing • Less effluent discharged and less environmental impact • Lower chemical cost
• Lower water usage	• Low water and energy costs • Less effluent discharge
• Chemicals suitable for minilabs with a washless cycle	• Additional water and energy savings • Lower effluent volume
• Process stability	• Consistent, repeatable print quality over a broad range of processor utilizations • Less need to adjust for low utilization • Fewer printer changes due to process shifts
• Patented 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

WHAT KODAK EKTACOLOR CHEMICALS ARE AVAILABLE?

KODAK EKTACOLOR Chemicals are available in a variety of sizes to meet the needs of any type of processing operation. Choose the sizes that are the most economical for you and that best meet your storage requirements.

The sizes listed in this publication are available in the U.S. and Canada; other regions may supply these chemicals in different sizes.

Chemicals for Large- and Medium-Volume Continuous Processors

These large sizes of KODAK EKTACOLOR RA Chemicals enable high-volume labs to make fewer mixes. Mix the solutions according to the directions packaged with the chemicals.

KODAK EKTACOLOR RA Developer Replenisher 12

This developer is designed specifically for continuous processors that have a utilization of at least one tank turnover per week. The developer time is the same as that recommended for EKTACOLOR RA Developer Replenisher; however, you must increase the developer temperature to 37.8°C (100.0°F).

Available in a size to prepare 150 gallons (568 litres) of replenisher solution.

KODAK EKTACOLOR RA Developer Regenerator 12/55

This regenerator enables you to collect and reuse overflow from EKTACOLOR RA Developer 12. With this regenerator, you do not need to use ion-exchange equipment. For information on using this regenerator, see Section 5, *Processing Options with KODAK EKTACOLOR Chemicals*.
Available in a size to prepare 150 gallons (568 litres) of replenisher from developer overflow.

KODAK EKTACOLOR RA Developer Replenisher

Use this developer if your processor's utilization is too low to use EKTACOLOR RA Developer Replenisher 12.

Available in sizes to prepare 25 gallons (95 litres) and 75 gallons (284 litres) of replenisher solution.

KODAK EKTACOLOR RA Developer Starter

Use this starter to prepare developer tank solution from EKTACOLOR RA Developer Replenisher, EKTACOLOR RA Developer Replenisher 12, EKTACOLOR PRIME SP Developer Replenisher LORR, EKTACOLOR RA Developer Replenisher RT, or EKTACOLOR Digital Developer Replenisher RT. Mix the solution according to the directions on the starter label.

Available in an 80-ounce (2.366 litre) bottle to prepare 25 gallons (95 litres) of tank solution from EKTACOLOR RA Developer Replenisher or EKTACOLOR RA Developer Replenisher RT and EKTACOLOR Digital Developer Replenisher RT or 20.8 gallons (78 litres) from EKTACOLOR RA Developer Replenisher 12.

KODAK EKTACOLOR RA Bleach-Fix and Replenisher NR

This bleach-fix is designed for continuous processors with high utilization. It features a low replenishment rate.

Available in sizes to prepare 20 gallons (76 litres) and 208 gallons (787 litres) of replenisher solution.

KODAK EKTACOLOR RA Bleach-Fix and Replenisher

Use this bleach-fix if your processor's utilization is too low to use EKTACOLOR RA Bleach-Fix and Replenisher NR. Use as a replenisher or a tank solution.

Available in a size to prepare 5 or 10 litres, or 25 gallons (95 litres) of solution.

KODAK EKTACOLOR RA Bleach-Fix Regenerator II

Use this bleach-fix for continuous processors with high utilization. (It is not recommended for use in roller transport processors.) After electrolytically desilvering the bleach-fix overflow, add this chemical to prepare the overflow for use as a replenisher. Regenerating the bleach-fix significantly reduces the BOD, COD, and iron in the effluent.

Available in a size to prepare 100 gallons (378.5 litres) of replenisher solution from desilvered bleach-fix overflow.

Chemicals for Minilabs

KODAK EKTACOLOR PRIME SP Developer Replenisher LORR

This developer replenisher is designed for minilabs with average to high utilization. Supplied as a single-part concentrate, it offers easy and convenient mixing and reduced replenishment rates.

Available in sizes to prepare 10 litres and 10-gallon sizes of replenisher solution.

KODAK EKTACOLOR RA Developer Starter

Use this starter to prepare developer tank solution. This starter will make 52.6 litres of tank solution from KODAK EKTACOLOR PRIME SP Developer Replenisher LORR or 95 litres of tank solution from EKTACOLOR RA Developer Replenisher RT, according to the direction on the starter label.

KODAK EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR

This single-part bleach-fix replenisher is designed for minilabs with average to high utilization. You can use this bleach-fix if your processor has a tank turnover at least every four weeks. The replenishment rate is 75 percent lower than that of EKTACOLOR RA Bleach-Fix and Replenisher.

Available in sizes to prepare 5 and 10 litres and 10 gallons (38 litres) of replenisher solution.

KODAK EKTACOLOR PRIME SP Bleach-Fix Starter

To make bleach-fix tank solution, mix this starter with KODAK EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR according to the directions on the starter label. *Makes 20 litres of tank solution.*

KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR

Use this stabilizer in place of a final wash in washless minilabs. Use as a replenisher or a tank solution.

Available in sizes to prepare 5 and 10 litres and 12.5 gallons (47 litres) of replenisher solution.

KODAK EKTACOLOR RA Developer Replenisher RT

If your minilab is operating in low utilization conditions, use this developer replenisher. See Section 3, page 3, for details on utilization requirements.

Available in sizes to prepare 10 litres and 25 gallons (95 litres) of replenisher solution.

KODAK EKTACOLOR RA Bleach-Fix and Replenisher

If your minilab is operating in low utilization conditions, use this replenisher. See Section 3, page 3, for details on utilization requirements. Use as a replenisher or a tank solution.

Available in sizes to prepare 10 litres and 25 gallons (95 litres) of solution.

Chemicals for Digital Printers / Processors Requiring Cartridges

KODAK EKTACOLOR Processing Cartridge 92/110

Use this cartridge in KODAK PROFESSIONAL RP 30 and SRP 30 Laser Printers. Each cartridge is mixed automatically and makes enough developer, bleach-fix, and stabilizer to process 92 square metres of professional paper (about 1770 8 x10-inch prints) or 110 square metres of EDGE or ROYAL Digital Paper (about 2120 8 x10-inch prints).

KODAK EKTACOLOR Processing Cartridge 111

Use this cartridge on all models of the FUJI Frontier Digital Minilab. It is a drop-in product that requires no changes or modification to the equipment or existing chemistry. Simply load the cartridge and continue processing. Each cartridge provides enough developer and bleach-fix to process 111 square metres of paper, or about 7170 4 x 6-inch prints.

KODAK EKTACOLOR PC 111 Tank Developer

Use this developer to prepare 4.2 litres of developer tank solution.

KODAK EKTACOLOR PC 111 Tank Bleach-Fix

Use this bleach-fix to prepare 4.2 litres of bleach-fix tank solution.

KODAK Rinse Tablets

Use these tablets on all models of the FUJI Frontier Digital Minilab. This is a drop-in product that requires no changes or modification to the equipment or existing chemistry. Just place the tablet in the slot on the machine and mix with water. Each tablet will make 5 litres of final rinse.

Chemicals for Roller-Transport and Low-Utilization Processors

KODAK EKTACOLOR RA Developer Replenisher RT

This developer has built-in protection from oxidation and evaporation that makes it particularly suitable for roller-transport processors and continuous or minilab processors operating in low utilization conditions.

Available in sizes to prepare 10 litres and 25 (95 litres) gallons of replenisher solution.

KODAK EKTACOLOR Digital Developer Replenisher RT

This developer is designed for commercial pro labs using Process RA-4. It produces increased color saturation and extra-high D-max (i.e., intense blacks) with KODAK PROFESSIONAL ENDURA Transparency and Clear Display Materials. It is primarily designed for digitally exposed output processed through roller-transport (RT) processors.

Available in sizes to prepare 50 gallons (189 litres) of replenisher solution.

KODAK EKTACOLOR RA Developer Starter

Add this concentrate to EKTACOLOR RA Developer Replenisher RT to prepare a developer solution for roller-transport processors.

Available in an 80-ounce (2.366 litres) bottle to prepare 25 gallons (95 litres) of tank solution from EKTACOLOR RA Developer Replenisher RT and EKTACOLOR Digital Developer Replenisher RT.

KODAK EKTACOLOR RA Developer Additive

If your processor's utilization is very low (requiring more than 8 weeks for a tank turnover), add this chemical to EKTACOLOR RA Developer Replenisher RT to provide additional protection from oxidation. Use this additive **only** with EKTACOLOR RA Developer Replenisher RT. Add this chemical *only* to the developer replenisher; *do not* add it directly to the developer working tank solution. Follow the directions on the bottle closely, because this additive requires a different dilution for the developer replenisher. Use the replenishment rates given in Section 4, *Using KODAK EKTACOLOR RA Chemicals in Professional Finishing Labs*; replenisher treated with this additive requires a different replenishment rate.

Available in a case of six 48-ounce (1.42 litre) bottles. Each bottle makes 15.6 gallons (59 litres) of developer replenisher from a 12 1/2-gallon size.

KODAK EKTACOLOR RA Bleach-Fix and Replenisher

Dilute and mix this concentrate for use as a replenisher or a tank solution.

Available in sizes to prepare 5 litres, 10 litres, and 25 gallons (95 litres) of solution.

KODAK EKTACOLOR RA Beach-Fix Additive

If your processor utilization is very low, you can add this solution to EKTACOLOR RA Bleach-Fix and Replenisher for additional oxidation protection. Add this chemical *only* to the bleach-fix replenisher; *do not* add it directly to the bleach-fix working tank solution.

Available in a case of six 48-ounce (1.42 litre) bottles.

CHEMICAL TERMS

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

Chemical Concentrates—Chemicals that are diluted to make replenishers or tank solutions.

Fresh Solution—A newly mixed, unused solution.

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

Regenerator—A solution or concentrate added to tank-solution overflow to convert it for reuse as a replenisher.

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—Concentrate added to a replenisher to prepare a fresh tank solution so that it yields 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.”

MIXING CHEMICALS

For the most current mixing instructions, follow those on the label of the chemical container or packaged with the chemicals. Be sure to follow all safety precautions and the handling recommendations under *Safe Handling of Photographic Chemicals*.

Table 1-1 summarizes the mixing instructions for EKTACOLOR Chemicals.

Table 1-1 Mixing KODAK EKTACOLOR Chemicals

EKTACOLOR RA or EKTACOLOR Chemical	Comments
Developer Replenisher Developer Replenisher RT Digital Developer Replenisher RT Developer Replenisher 12	Mix at 21 to 38° C (70 to 100° F). The mixing order is important with developer replenishers because Part A contains the preservatives. Therefore, add Part B only after allowing Part A to mix for at least two minutes, and add Part C only after allowing Part B to mix for at least two minutes. Failure to do so may result in the formation of precipitates that are very difficult to redissolve. Once the final kit parts are added, agitate enough to mix the developer completely, typically not more than 5 minutes, and be sure that mixing does not draw air into the solution. NOTE: Digital Developer Replenisher RT only has two parts, Part A and Part B.
Developer Regenerator 12/55	See Section 5, <i>Processing Options with KODAK EKTACOLOR Chemicals</i> , and the instructions packaged with the chemicals.
PRIME SP Developer Replenisher LORR	Add the single-part concentrate to warm water (at 21 to 38° C [70 to 100° F]). Rinse the concentrate bottle with a small amount of water, and add the water to the mix.
Bleach-Fix Bleach-Fix and Replenisher Bleach-Fix and Replenisher NR PRIME SP Bleach-Fix and Replenisher LORR	Mix at 21 to 38° C (70 to 100° F). The chemicals mix easily. The bleach-fix and replenisher should be dark red when completely mixed.
Bleach-Fix Regenerator II	See Section 5, <i>Processing Options with KODAK EKTACOLOR Chemicals</i> , and the instructions packaged with the chemicals.
PRIME Stabilizer and Replenisher LORR	Mix at 21 to 35° C (70 to 95° F). Excessive agitation can cause foaming.

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. 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

To reduce the possibility of contamination, take care to avoid dripping solution into other tanks when you remove racks for cleaning, avoid splashing by not agitating too vigorously, and check that processing and mixing equipment and plumbing are made of suitable material. If possible, use a separate set of mixing equipment to mix each type of solution, and wash all equipment *thoroughly* before you reuse it.

Using separate mixing tanks may not always be practical or possible. Table 1-2 gives mixing arrangements for one to four mixing tanks. Use it as a guide for using your mixing tanks in the best manner to reduce the possibility of contamination.

- If you mix only chemicals for NEGATIVE processes, use two mix tanks: one for developer and one for all other solutions.
- If you mix chemicals for NEGATIVE and REVERSAL processes, use four mix tanks: one for the negative developer and the reversal first developer; one for color developer; one for bleach and bleach-fix; and one for all other solutions.

Remember also that good housekeeping (e.g., keeping the mixing area clean, neat, and well ventilated; proper storage of chemicals, etc.) will reduce the possibility of contamination and provide safer working conditions.

Table 1-2 Configurations for Chemical Mixing Tanks

If you have ONE tank:
<p>Reduce the chance of chemical contamination by using four separate mixing tanks. If you cannot use four separate tanks, do the following before mixing different batches of chemicals:</p> <ul style="list-style-type: none"> • Thoroughly rinse the tank and mixing equipment with room-temperature water • Flush tubing and lines • Thoroughly clean transfer pumps
If you have TWO tanks:
<p>Use the FIRST tank for:</p> <ul style="list-style-type: none"> • Black-and-white developers • First developer for Process E-6 • Color developer for Process RA-4 and C-41, and for Process E-6 Color Developer
<p>Use the SECOND tank for:</p> <ul style="list-style-type: none"> • All stop baths and stabilizers • Reversal bath, pre-bleach, and final rinse for Process E-6 • All bleaches, fixers and bleach-fixes • Final rinse for Process C-41
If you have THREE tanks:
<p>Use the FIRST tank for:</p> <ul style="list-style-type: none"> • Black-and-white developers • First developer for Process E-6 • Color developer for Process RA-4 and C-41, and for Process E-6 Color Developer
<p>Use the SECOND tank for:</p> <ul style="list-style-type: none"> • All stop baths and stabilizers • Reversal bath, pre-bleach, and final rinse for Process E-6 • Final rinse for Process C-41
<p>Use the THIRD tank for:</p> <ul style="list-style-type: none"> • All bleaches, fixers, and bleach-fixers
If you have FOUR tanks:
<p>Use the FIRST tank for:</p> <ul style="list-style-type: none"> • Black-and-white developers • First developer for Process E-6
<p>Use the SECOND tank for:</p> <ul style="list-style-type: none"> • Color developer for Process RA-4 and C-41, and for Process E-6 Color Developer
<p>Use the THIRD tank for:</p> <ul style="list-style-type: none"> • Stop baths and stabilizers • Reversal bath, pre-bleach, and final rinse for Process E-6 • Final rinse for Process C-41
<p>Use the FOURTH tank for:</p> <ul style="list-style-type: none"> • All bleaches, fixers, and bleach-fixers

Water Quality

Water can have a significant effect on photographic quality. Generally, most municipal or public water supplies are sufficiently pure for photographic use. Note that the quality of water supplies can vary seasonally, and it is a good idea to have your water supply tested periodically.

Water for photographic processing should be free of color, suspended material, and heavy metals, and should not be excessively hard. For mixing processing solutions, the water should have less than 250 ppm of total dissolved solids (less than 1000 ppm for wash water). The pH of water should be 6.5 to 8.5 and should not be highly buffered. Practical limits for common water impurities for photographic processing are listed in Table 1-3. If you use well water, be sure to have the water tested for the impurities listed in Table 1-3.

Also, poor plumbing materials (e.g., old, rusty pipes or pipes made of the wrong material) can be a source of dirt and contamination. Check your plumbing and replace it if necessary.

Table 1-3 Practical Limits of Impurities for Water Used in Photographic Processing

Impurity	Acceptable Limit or Range (ppm)
Color, suspended material	None
Dissolved solids	250
pH	6.5 to 8.5
Hardness, as CaCO ₃	40 (preferable) to 150
Copper, iron, manganese	0.10 each
Chlorine, as free hypochlorous acid	2
Chloride	100
Bicarbonate	150
Sulfate	200
Sulfide	0.10
Silica	20.0

Note: If analysis of water shows a marked deviation from the amounts in Table 1-3, consult a water-conditioning company to determine the most suitable method of treatment or filtration of the water.

Construction Materials for Processing Equipment

It is important to use the proper construction materials for processing equipment.

Developers—Use Type 316 stainless-steel tanks for developers. Some plastic materials, such as PVC and polyethylene, are also acceptable.

Bleach-Fix—Bleach-fix rapidly corrodes brass and copper. Avoid all contact of these materials with the bleach-fix. The best material to use for the bleach-fix and the wash tanks following the bleach-fix is Type 316 stainless steel. Several plastic materials, such as PVC and polyethylene, are also acceptable. When you discharge bleach-fix to the drain, flush it with a large volume of running water to avoid corroding metal pipes.

Clean Your Processor Tanks and Racks Regularly

Always wear splash-proof goggles and protective gloves and apron when you clean 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 daily 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, loose screws, deteriorated retaining clips, etc., to ensure smooth transport of paper.
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 such as KODAK Developer System Cleaner and Neutralizer for developer tanks and KODAK Fixer/Wash Systems Cleaner for bleach-fix, fixer and wash tanks (follow the instructions provided with these products). Rinse racks and tanks thoroughly before you refill the tanks.

Removing Biological Growth—Biological growth can occur in stabilizer and wash tanks. This is a potential source of dirt. Clean wash tanks weekly and stabilizer tanks as needed. To remove biological growth:

1. Empty the processing solution or wash water from the tank. Dispose of waste solutions according to disposal regulations.
2. Rinse the tanks and racks with hot water; drain the rinse water and repeat.

DANGER! The addition of cleaning agents that contain strong acids or oxidizing agents (e.g., chlorine-containing bleaches) to thiocyanate-containing photoprocessing solutions (i.e., some fixer solutions) may release poisonous and flammable hydrogen cyanide gas, as well as other irritating and toxic gases, such as cyanogen chloride and sulfur dioxide. **Do not** add cleaning agents to processing tanks unless the tanks, racks, and recirculation system have been completely drained and thoroughly flushed and rinsed with water. Read the Material Safety Data Sheet for information on the potential hazards of the working tank solution.

3. Fill the tanks with sodium hypochlorite (NaOCl) solution, such as 2 mL Clorox (5.25 percent NaOCl) or 1 mL Sunny Sol (12.5 percent NaOCl) per litre of water. (Note the caution above.)
4. Allow the hypochlorite solution to remain in the tanks for up to 30 minutes. Longer dwell 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 the tanks and racks.
6. Before refilling the 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 more information on the recommended methods for cleaning processing tanks, in the U.S., contact the Kodak Information Center at 866-352-4367. In Canada, call 800-465-6325. In other regions, contact Kodak in your country. For information on controlling biological growth, go to www.kodak.com/go/photochemicals for KODAK Publications CIS-3, *Biocides for Photographic Solution Tanks and Wash Water* and CIS-167, *Removal of Silver Sulfide from Fixer, Bleach-Fix, Wash or Stabilizer Racks/Rollers in Photographic Processes*.

CHECKING CHEMICALS AND CHEMICAL MIXES

Fresh 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 or if a solution was mixed correctly. Table 1-4 summarizes the characteristics of EKTACOLOR Chemicals and solutions. You can check your mixes for possible mixing errors by using specific-gravity measurements. For information on making specific-gravity measurements, see *Check Your Mixes with Specific-Gravity Measurements*.

Table 1-4 Characteristics of KODAK EKTACOLOR Chemicals

EKTACOLOR Chemical	Appearance of Concentrates	Normal Appearance of Mixed Replenisher	Comments
Developer Developer Replenisher RT Developer Replenisher 12	Part A — clear, yellow to reddish amber; amine odor Part B — Clear amber to tan; sulfite odor Part C — Clear, colorless; odorless	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 appearance of mixed replenisher is dark, opaque, it is oxidized, do not use.
Digital Developer Replenisher RT	Part A — clear, amber to reddish amber; amine odor Part B — Clear to yellow	Pale yellow to amber	Darkens slightly with age/storage, this will not affect activity. If appearance of Part A concentrate is dark, opaque, solution is oxidized, do not use. If mixed replenisher is dark, opaque, it is oxidized, or if precipitate is present, do not use.
PRIME SP Developer Replenisher LORR	Clear, yellow-amber to orange; fresh odor	Pale amber to amber	Appearance of concentrate can darken slightly with age/storage, this will not affect activity. If the appearance of the concentrate or mixed replenisher is dark, opaque, solution is oxidized, do not use.
Developer Starter	Clear, colorless; odorless	—	—
Bleach-Fix Replenisher	Part A — Clear, colorless, slight ammonia odor Part B — Dark red-brown	Dark red-brown	Do not allow concentrate to freeze, as precipitate may form. Age, exposure to high temperature, or oxidation can cause sulfurization of Part A or of mixed replenisher. Severely degraded bleach-fixes can produce a large amount of white to yellow precipitate (sulphur) and may have a hydrogen sulfide odor. (i.e., rotten egg odor).
PRIME SP Bleach-Fix and Replenisher LORR	Dark red-brown, slight acetic acid odor	Dark red-brown	
PRIME SP Bleach-Fix Starter	Dark red-brown	—	—
PRIME Stabilizer and Replenisher LORR	Clear, colorless to pale green	Clear, colorless	—

Check Your Mixes with Specific-Gravity Measurements

Specific gravity is the ratio of the mass of a liquid to the mass of an equal volume of water at a specific temperature. Specific gravity provides a convenient way to measure the total dissolved material in a solution. Its primary use with EKTACOLOR Chemicals is to check for mixing errors in freshly mixed solutions. The specific-gravity range for a seasoned tank solution makes readings more variable.

How to Measure Specific Gravity—To make specific-gravity measurements of EKTACOLOR Chemicals, use a hydrometer that meets the standard ASTM E100-05. The hydrometer should be marked in increments of 0.001 for an accuracy of ± 0.0005 . Although most hydrometers are calibrated at 15.5°C (60°F), you can use them at other temperatures. Table 1-5 gives typical specific-gravity ranges for fresh mixes and seasoned tank solutions of KODAK EKTACOLOR Chemicals at a temperature of 25°C (77°F). To measure specific gravity:

1. Choose a hydrometer with a range suitable for the solution you are measuring.
2. Fill a clean, dry 250 mL graduated cylinder to within 2.5 cm (1 inch) of the top with the solution you are measuring. Place the cylinder in a sink or tray to catch overflow.
3. Adjust the solution to $25.0 \pm 1^\circ\text{C}$ ($77 \pm 2^\circ\text{F}$). Proper solution temperature is very important.
4. Be sure that the hydrometer is clean and dry. Carefully lower it into the solution. Be sure that the hydrometer floats freely.
5. Read the number on the hydrometer stem at the top of the meniscus of the solution.
6. Compare your reading with the approximate number in Table 1-5. Specific-gravity values that are lower than normal indicate that your solution is too dilute. If the values are higher than normal, your solution is too concentrated.
7. After making the measurement, discard the sample. To avoid contaminating solutions, **do not** return the sample to the tank.
8. Rinse the hydrometer and graduated cylinder thoroughly with water.

Note: Never take specific-gravity readings of solutions in the tanks. If you use the wrong hydrometer, it can sink to the bottom of the tank and break, or bob on the surface, where the stem may hit the edge of the tank and break. Label hydrometer boxes to avoid confusion. **Do not** tape labels on hydrometers.

Table 1-5
Acceptable Specific-Gravity Ranges for KODAK EKTACOLOR
Chemical Solutions at 25°C (77°F)

KODAK EKTACOLOR Chemical	Specific Gravity at 25° C (77° F)		
	Fresh Tank	Seasoned Tank	Replenisher
Developer	1.017 to 1.023	1.027 to 1.035	1.024 to 1.030
RA 12 Developer Replenisher	1.019 to 1.025	1.028 to 1.036	1.022 to 1.028
RA 12/55 Regenerator	NA	1.032 to 1.040	1.029 to 1.037
RA Developer Replenisher RT	1.017 to 1.023	1.026 to 1.034	1.020 to 1.026
Digital Developer Replenisher RT	1.022 to 1.028	1.027 to 1.035	1.027 to 1.033
RA Developer Replenisher RT (with Additive)	NA	NA	1.018 to 1.024
PRIME SP Developer LORR	1.018 to 1.028	1.027 to 1.035	1.023 to 1.031
Processing Cartridge PC 92/110 Developer	1.030 to 1.036	1.032 to 1.042	1.034 to 1.042
Processing Cartridge PC111 Developer	NA	1.039 to 1.047	1.041 to 1.049
RA Bleach-Fix NR	1.060 to 1.070	1.080 to 1.110	1.125 to 1.135
RA Bleach-Fix	1.070 to 1.080	1.066 to 1.096	1.070 to 1.080
Processing Cartridge PC 92/110 Bleach-Fix	—	1.090 to 1.120	1.113 to 1.123
Processing Cartridge PC111 Bleach-Fix	NA	1.090 to 1.120	NA

STORING CHEMICAL CONCENTRATES AND SOLUTIONS

How well you store chemical concentrates and solutions may affect the activity of processing solutions. For the most up-to-date source of information on mixing and storing chemicals, see the instructions packaged with the chemicals.

Storage Temperature—Store *unmixed chemical concentrates* in a dry location at a temperature of 7 to 30°C (45 to 86°F). Lower temperatures may cause components to come out of solution or crystallize. Higher temperatures can accelerate chemical reactions and cause deterioration.

Store *mixed solutions* in polyethylene storage tanks at approximately 21°C (70°F). If a replenisher is stored at a temperature that is too low, it can affect the temperature of the tank solution. Too high a storage temperature accelerates oxidation and evaporation.

Storage Tanks and Containers—Equip storage tanks with floating lids and dust covers to minimize evaporation and protect solutions from dust and dirt.

Once you open the original container, the chemical concentrates are exposed to oxygen that will react with the chemicals and gradually cause them to deteriorate. This is especially true of developers. Oxidation occurs to some extent even if you immediately reseal the container.

Store drums upright to expose as little surface area to the air as possible.

Length of Storage Time—For best results, **do not** use solutions stored longer than the times given in Table 1-6.

Table 1-6 Solution Storage Times

Mixed Solutions	Solution in Processor—No Operation	Replenisher in Covered Tank with Floating Lid
EKTACOLOR RA Developer EKTACOLOR RA Developer RT	1 week	6 weeks
EKTACOLOR Developer 12 EKTACOLOR RA Developer Regenerator 12/55	1 week	3 weeks
EKTACOLOR PRIME SP Developer LORR	1 week	3 weeks
All other solutions	2 weeks	8 weeks

SAFE HANDLING OF PHOTOGRAPHIC CHEMICALS

Every substance we come into contact with is composed of chemicals—the food we eat, the air we breathe, the clothing we wear, the medicine we take. Although most of these chemicals are not hazardous, you may need to take precautions to limit the exposure to some chemicals that could be harmful. For example, direct skin or eye contact with or inhalation of vapors or mists from some household cleaning products can be irritating.

When handled properly, photographic processing chemicals are safe to use. Follow the guidelines below to minimize the potential hazardous effects of these chemicals.

Be Informed

Safe handling of chemicals requires that you recognize and avoid the potential hazards. Learning more about photographic processing chemicals reduces the possibility of illness or injury.

Occupational Health and Safety Regulations

The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard requires chemical manufacturers to label their products properly and to provide Material Safety Data Sheets (MSDSs) for hazardous chemicals. OSHA also requires employers to make MSDSs available in the workplace for the purpose of proper chemical container labeling, and to train employees on the safe use of chemicals. Local emergency responders may also require MSDS's to be on hand.

Product Labels

Kodak provides warning and precautionary statements on product labels, instruction sheets, and packaged products. Kodak also provides labels for processor and replenisher tanks. Kodak evaluates photographic processing chemicals for potential health and physical hazards. When a photographic processing chemical has little, if any, potential hazard, the statement "LOW HAZARD FOR RECOMMENDED HANDLING" is included on the label. Photographic processing chemicals that are potentially hazardous have appropriate precautionary statements, such as the following:

Signal Word

-For example, "CAUTION," "WARNING," or "DANGER!"

Statement of Hazard

-For example, "CAUSES SKIN AND EYE BURNS," "HARMFUL IF ABSORBED THROUGH THE SKIN," or "FLAMMABLE."

Precautionary Wording

-For example, "Do not get in eyes, on skin, or on clothing" or "Keep away from heat, sparks, and flame."

First-Aid Statements

-Included on labels and signs to describe immediate measures you must take in case of contact with or overexposure to a photographic processing chemical.

Material Safety Data Sheets

Photographic processing facilities are required by OSHA to have MSDSs for all hazardous chemicals. MSDSs provide detailed information about each product. Information included in MSDSs is outlined in the following categories: chemical and manufacturer identification; composition/ingredients; hazard identification; first-aid measures; fire-fighting measures; accidental release measures; handling and storage; exposure controls and personal protection; physical and chemical properties; stability and reactivity; toxicological information; ecological issues; disposal issues; transport issues; regulatory issues; and other information.

Kodak provides customers with MSDSs for all photographic processing chemicals. If you need replacement(s) or extra MSDSs for any Kodak chemical, visit the Kodak website at www.kodak.com/go/MSDS or call 1 800 242 2424. You will need to supply the catalog (CAT) number of the products for which you need MSDSs.

Training

OSHA requires that all employees be trained on the safe handling of photographic processing chemicals and general lab safety prior to their initial assignment and whenever new hazards are introduced into the workplace. Employees should be familiar with the OSHA Hazard Communication Standard, operations where hazardous chemicals are present, the location and content of Material Safety Data Sheets, physical and health hazards of chemicals in their work area, and additional topics. For more information on OSHA's Hazard Communication Standard, see KODAK Publication No. J-311, *Hazard Communication for Photographic Processing Facilities*. You may also want to review KODAK Publication No. J-98R, *Health, Safety, and Environmental Program*.

Handle Chemicals Properly

Once you know the hazards, learn how to handle chemicals safely. Safe handling practices include wearing personal protective equipment, following procedures that minimize chemical contact, and following the instructions on chemical labels. If contact occurs, know how to treat or obtain medical/first-aid assistance.

Protective Equipment and Clothing

OSHA requires that personal protective equipment (PPE) be used in the workplace whenever the possibility of chemical contact exists. OSHA also requires that you perform a hazard assessment in your facility to determine what type of personal protective equipment is required to protect against the hazards present. In general, the personal protective equipment required for handling photographic processing chemicals includes:

- Neoprene or nitrile gloves
- Safety goggles
- Vinyl or rubber apron or lab coat

Check personal protective equipment often to make sure it is in good working condition, is clean, and works and fits properly. Training must be provided on the use, limitations, and maintenance of personal protective equipment. For more information, see KODAK Publication No. J-312, *Personal Protective Equipment Requirements for Photographic Processing Facilities*.

Corrosive Materials

Certain photographic processing chemicals contain materials that can burn or irritate the skin and eyes, sometimes with only brief contact. To reduce the possibility of injury, always wear personal protective equipment when handling photographic processing chemicals. Also make sure an emergency eyewash station is readily available.

Contact Dermatitis

Dermatitis is the medical term used to describe a skin inflammation. Contact with some materials, such as acids and bases, can cause irritative contact dermatitis, while other chemicals, such as photographic developers, may cause allergic contact dermatitis.

Early symptoms of **irritative contact dermatitis** may include dry, red, cracked, or scaly skin at the site of contact. Symptoms may worsen with continued chemical exposure. In most cases of **allergic contact dermatitis**, the symptoms are itchy blisters similar to those seen from exposure to poison ivy or poison oak. Although the rash is usually confined to the site of contact, most often fingers, hands, and forearms, it may spread to other areas.

Sometimes people can work with a chemical for years without any noticeable effect, only to develop contact dermatitis at a later date. The time between contact and when a response develops varies widely among individuals. People with a history of skin allergies, eczema, or other skin disorders may be more susceptible to the effects of contact with chemicals.

If you think you have developed contact dermatitis, contact your manager. A medical examination may be required to determine the cause of the problem. **Do not** attempt to self-medicate with lotions or creams; they may make the problem worse.

To **prevent contact dermatitis** when handling photographic processing chemicals, follow these guidelines:

- **Read the labels** on chemical containers so that you know what precautions to take when handling the contents.
- **Avoid contact with chemicals whenever possible.** Handle chemical solutions carefully to avoid splashing. Keep all personal protective equipment (gloves, goggles, apron, etc.) free of chemical residues.
- **Wear the proper gloves.** Do not use gloves sold for household use; they may not be durable enough for handling photographic processing chemicals. Neoprene or nitrile gloves protect you from photographic processing chemicals. To minimize the possibility of chemicals coming in contact with your bare hands, rinse gloves thoroughly with water before taking them off. On a regular basis or if chemicals get inside the gloves, wash them inside and out, and hang them by the fingertips to dry.
 - Check gloves regularly for pinholes, leaks, or tears.
 - Dispose of gloves when they are damaged or begin to degrade.
 - Barrier creams ARE NOT an acceptable substitute for gloves.
- **In case of contact with chemicals, wash your hands or other affected skin areas immediately** with plenty of water. Wash with a mild soap or pH-balanced cleanser (like pHhisoderm or pHotoDerm). Avoid using harsh or abrasive soaps or hand cleaners.
- **Protect skin abrasions or cuts.** The risk of contact dermatitis is increased if chemicals penetrate the skin. Skin damaged by cuts or abrasions is especially susceptible to irritants.
- **Change and launder clothing worn while handling chemicals.** If photographic processing chemicals are splashed or spilled on your clothes, immediately rinse the clothes to remove the chemical residue. Wash contaminated clothing before wearing it again.
- **Clean up chemical spills or splashes immediately.** Always wear personal protective equipment when cleaning up spilled photographic processing chemicals. Follow the directions under "Accidental Release Measures" in the MSDS. To prevent a potentially dangerous chemical reaction, never use soaps, bleaches, or other cleaners directly on a spill.
- **Immediately report any unusual skin condition** that you think might be related to photographic processing chemicals to your manager and to your physician. Conditions such as contact dermatitis can be caused by materials other than photographic processing chemicals; dermatitis usually will not improve until the cause is found and the condition is properly treated.

Absorption of Chemicals Through the Skin

Some chemicals are able to enter the body by absorption through the skin. A variety of factors determines the effects of these chemicals, including the toxicity of the chemical, its concentration, and the duration of skin contact. Chemicals can have a toxic effect even without skin irritation. If tests indicate that a photographic processing chemical may be absorbed through the skin in amounts that could cause an adverse effect, the product label will include a precautionary statement, such as "HARMFUL IF ABSORBED THROUGH THE SKIN." Always wear personal protective equipment when handling these chemicals.

Ventilation

Proper ventilation is important to ensure a safe and comfortable indoor air environment for photographic processing areas. Several common potential indoor air contaminants can be associated with photographic processing. These include acetic acid, sulfur dioxide, and ammonia. These chemicals may be eye and respiratory tract irritants depending on their airborne concentrations. OSHA and other agencies have established exposure guidelines and standards that represent concentrations under which it is believed that nearly all employees may be repeatedly exposed to these chemicals without adverse health effects. If significant eye or respiratory tract irritation occurs during normal photographic processing or maintenance operations, this may indicate elevated levels of these materials and the need for better control.

For more information, see KODAK Publication No. J 314, *Indoor Air Quality and Ventilation in Photographic Processing Facilities*.

Photographic Chemicals in a Home Darkroom

Photographic chemicals used in home darkrooms are essentially the same as those used in commercial photoprocessing labs, but they are used in smaller volumes and less frequently. The safety precautions are the same as those required for commercial labs. However, it is important to take extra precautions for storage and use to protect young children and pets.

Know First Aid in Case of an Emergency

Appropriate first-aid treatment is included in the MSDS and on the product and processor labels. First aid should be used for immediate treatment in the event of an emergency and is not intended to replace medical attention. Do not administer first aid to others unless you have been specifically trained to do so.

Chemical Splashes

If a chemical gets into a person's eye(s), use an eyewash station to thoroughly flush the eye(s). Get medical attention, if necessary.

If you get chemicals on your clothing, thoroughly rinse the affected clothes to remove all of the chemical residue. Use water to rinse the skin area where the chemical contact took place. If the chemical is a developer, wash with a pH-balanced cleanser. Wash contaminated clothing before wearing it again. Thoroughly clean contaminated shoes; if they cannot be cleaned, discard them.

Swallowed Chemicals

Immediately identify which chemical was swallowed and follow the first-aid recommendations on the container/processor label and in the MSDS. Call a physician or poison-control center as quickly as possible; make sure you have the MSDS with you when you call.

Inhaled Vapors and Gases

Immediately get fresh air. If symptoms persists, get medical attention.

Store Chemicals Safely

Keep containers easily accessible-

Always store photographic processing chemical containers in a designated area, away from heavy traffic, where they can be identified and inventoried. Position containers in an area where you can easily reach them without having to stretch.

Do not remove chemical labels-

Container labels include the chemical name, appropriate hazard warnings, and precautionary measures where applicable.

Processor tanks and other storage tanks also need to be properly labeled. Kodak provides hazard warning labels for this purpose.

Use the proper containers-

Store photographic processing concentrates in the containers in which they were originally delivered. Do not transfer chemicals into any other containers.

Keep corrosive materials separated-

Store corrosive materials away from any materials with which they may react, and away from other incompatible materials. See the stability and reactivity section on the MSDS for more information.

Dispose of Photographic Chemicals Properly

Always follow the procedures designated for your photographic processing facility when disposing of photographic processing chemicals. These disposal procedures are based on local, state, and federal requirements that regulate the disposal of photographic processing chemicals.

If your facility discharges waste solutions, make sure you have reviewed the local sewer discharge requirements for your area. Use silver-recovery methods for silver-bearing effluents (e.g., used fixers, bleach-fixes, and stabilizers). Also, know what other materials may be discharged to a common drain. Never pour any photographic processing chemicals into a drain where cleaning agents containing chlorine are present unless the drain has been thoroughly rinsed. Run plenty of water down the drain prior to disposing of photographic processing chemical effluents. Then thoroughly rinse the drain again after disposal of effluents.

For more information on silver recovery, see KODAK Publication No. J 212, The Technology of Silver Recovery for Photographic Processing Facilities.

If off-site treatment (hauling) is used for the disposal of waste photographic processing solutions, make sure the only solutions poured into the waste drum(s) are photographic processing solutions.

Regardless of the type of recovery or disposal procedure you use in your facility, maintain the system so that overflows and spills do not occur.

Summary

Safe handling of photographic chemicals is easy when you use common sense and follow these guidelines:

- Know the chemicals you are handling.
- Read the MSDSs and container labels.
- Protect your eyes and skin by wearing personal protective equipment.
- Use caution when mixing and pouring photographic processing chemical solutions into processor tanks.
- Use care when moving containers from one location to another.
- Store photographic processing chemicals safely.
- Do not eat, drink, or smoke in chemical-handling areas.

EFFLUENT DISPOSAL

Effluent from processing labs that use KODAK EKTACOLOR Chemicals consists of developer, desilvered bleach-fix, and wastewater or stabilizer. This effluent is compatible with and can be effectively treated by a municipal secondary wash-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 lab using Process RA-4 has the characteristics listed in Table 1-7.

Table 1-7 Effluent Characteristics

pH	6.5 to 9
Temperature	Less than 30°C (90°F)
Silver	Less than 5 mg/L
Suspended solids	Less than 50 mg/L
Oils, greases, detergents	None
Flammable, explosive, or toxic materials	None

Effluent from processes that use 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 dilution by effluent from other processes and non-processing wastewater. 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.

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.

Consider silver recovery as part of your normal processing operation. For more information on choosing a silver-recovery method, see KODAK Publication No. J-212, *The Technology of Silver Recovery for Photographic Processing Facilities*. For more information on how much silver can be recovered, see KODAK Publication No. J-210, *Sources of Silver in Photographic Processing Facilities*. For more information on techniques for measuring silver in a photographic processing lab, see KODAK Publication No. J-211, *Measuring Silver in Photographic Processing Facilities*.

If you have other questions about discharging EKTACOLOR Chemicals or other environmental concerns, 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.

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.

Simplified Metric Conversion Charts

Volume, Length, and Weight

Because most laboratory measuring devices are calibrated in metric units, this summary includes tables for converting U.S. units of volume, length, and weight to metric units. **Do not** use Table 1-8 to convert from metric to U.S. values. Accuracy of the table is within one percent. This degree of accuracy is adequate for most measurements in a photoprocessing laboratory (e.g., replenishment rates, safelight distances, equipment location, etc.). To use Table 1-8, find the number you are converting 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.

Table 1-8 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	81.7	185.5
U.S. Fluidounces 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 Table 1-9 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 .03382 = 15.22 fluidounces).

Table 1-9 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

To convert a temperature from one unit of measure to another, use the following table. Find the temperature you are converting 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.

Table 1-10 Temperature Conversion Chart

to °C	°F or °C	to °F	to °C	°F or °C	to °F	to °C	°F or °C	to °F	to °C	°F or °C	to °F
37.78	100	212.0	22.22	72	161.6	7.22	45	113.0	-7.78	18	64.4
37.22	99	210.2	21.67	71	159.8	6.67	44	111.2	-8.33	17	62.6
36.67	98	208.4	21.11	70	158.0	6.11	43	109.4	-8.89	16	60.8
36.11	97	206.6	20.56	69	156.2	5.56	42	107.6	-9.44	15	59.0
35.56	96	204.8	20.00	68	154.4	5.00	41	105.8	-10.00	14	57.2
35.00	95	203.0	19.44	67	152.6	4.44	40	104.0	-10.56	13	55.4
34.44	94	201.2	18.89	66	150.8	3.89	39	102.2	-11.11	12	53.6
33.89	93	199.4	18.33	65	149.0	3.33	38	100.4	-11.67	11	51.8
33.33	92	197.6	17.78	64	147.2	2.78	37	98.6	-12.22	10	50.0
32.78	91	195.8	17.22	63	145.4	2.22	36	96.8	-12.78	9	48.2
32.22	90	194.0	16.67	62	143.6	1.67	35	95.0	-13.33	8	46.4
31.67	89	192.2	16.11	61	141.8	1.11	34	93.2	-13.89	7	44.6
31.11	88	190.4	15.56	60	140.0	0.56	33	91.4	-14.44	6	42.8
30.56	87	188.6	15.00	59	138.2	0.00	32	89.6	-15.00	5	41.0
30.00	86	186.8	14.44	58	136.4	-0.56	31	87.8	-15.56	4	39.2
29.44	85	185.0	13.89	57	134.6	-1.11	30	86.0	-16.11	3	37.4
28.89	84	183.2	13.33	56	132.8	-1.67	29	84.2	-16.67	2	35.6
28.33	83	181.4	12.78	55	131.0	-2.22	28	82.4	-17.22	1	33.8
27.78	82	179.6	12.22	54	129.2	-2.78	27	80.6	-17.78	0	32.0
27.22	81	177.8	11.67	53	127.4	-3.33	26	78.8	-18.33	-1	30.2
26.67	80	176.0	11.11	52	125.6	-3.89	25	77.0	-18.89	-2	28.4
26.11	79	174.2	10.56	51	123.8	-4.44	24	75.2	-19.44	-3	26.6
25.56	78	172.4	10.00	50	122.0	-5.00	23	73.4	-20.00	-4	24.8
25.00	77	170.6	9.44	49	120.2	-5.56	22	71.6	-20.56	-5	23.0
24.44	76	168.8	8.89	48	118.4	-6.11	21	69.8	-21.11	-6	21.2
23.89	75	167.0	8.33	47	116.6	-6.67	20	68.0	-21.67	-7	19.4
23.33	74	165.2	7.78	46	114.8	-7.22	19	66.2	-22.22	-8	17.6
22.78	73	163.4							-22.78	-9	15.8

For temperatures not shown in Table 1-10, use the following calculations:

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

2 Using KODAK EKTACOLOR Chemicals in Continuous Processors

This section lists the recommended steps, conditions, and replenishment rates for processing Kodak Color Papers in continuous processors using Process RA-4. KODAK supplies EKTACOLOR Chemicals for use in continuous processors, which are available in sizes specially designed for continuous processors. For a listing of available sizes, see Section 1, KODAK EKTACOLOR Chemicals. Use these chemicals for processing Kodak Color Papers designed for Process RA-4, such as:

- KODAK EKTACOLOR EDGE Paper
- KODAK ROYAL Digital Paper
- KODAK ROYAL Luminous Digital Paper
- KODAK Photo Book Paper
- KODAK PROFESSIONAL SUPRA ENDURA VC Digital Paper
- KODAK PROFESSIONAL ULTRA ENDURA Paper
- KODAK PROFESSIONAL ULTRA ENDURA High Definition Paper
- KODAK PROFESSIONAL ENDURA Metallic VC Paper

Processing options are available for Process RA-4, such as developer regeneration and bleach-fix regeneration. These options are described in Section 5, *Processing Options with KODAK EKTACOLOR Chemicals*.

For information on handling and mixing KODAK EKTACOLOR Chemicals, see Section 1, *KODAK EKTACOLOR Chemicals*. For information on monitoring your process, see Section 6, *Process Monitoring and Troubleshooting with KODAK Control Strips, Process RA-4*.

CONTINUOUS PROCESSORS

Steps and Conditions

To use Process RA-4, your processor must be capable of operating at the processing times required.

Table 2-1 Processing Steps and Conditions for Process RA-4—Continuous Processors

Solution/Step	Time* min:sec	Temperature† °C (°F)	Maximum Weeks per Tank Turnover	Comments
EKTACOLOR RA Developer Replenisher 12 or EKTACOLOR Developer Regenerator 12/55‡ or	0:45	37.8 ± 0.3 (100.0 ± 0.5)	1	Recirculate and filter. Use precise temperature control. Use squeegees at tank exit.
EKTACOLOR RA Developer Replenisher	0:45	35.0 ± 0.3 (95.0 ± 0.5)	4	
EKTACOLOR RA Bleach-Fix and Replenisher or EKTACOLOR RA Bleach-Fix and Replenisher NR	0:45	32 to 38 (90 to 100)	4	Recirculate and filter. Use squeegees at tank exit.
Wash	1:30	30 to 40 (86 to 104)		
Dry	As needed	Not over 96 (205)		

* Immersion time plus crossover time to the next tank. Developer time range is 44 to 48 seconds. Minimum times for the bleach-fix and wash can be one second less than the normal times. Longer times reduce the benefit of a shorter process cycle, but cause no other adverse effect. For best results, use the recommended times with crossover times of 6 seconds or less.

† Check the developer temperature frequently with an accurate thermometer.

‡ KODAK EKTACOLOR RA Developer 12/55 Regenerator significantly reduces the waste volume, and lowers chemical costs. See Section 5, *Processing Options with KODAK EKTACOLOR Chemicals*. If you do not use regenerator, use EKTACOLOR RA 12 Developer Replenisher.

Squeegees

Install squeegees at the exit of the last developer tank and the last bleach-fix tank to reduce solution carryover. Reducing solution carryover by using efficient squeegees permits lower replenishment rates and more efficient silver recovery from the bleach-fix overflow. Typical carryover rates with good squeegees are 43 to 65 mL/m² (4 to 6 mL/ft²); however, if carryover exceeds 54 mL/m² (5 mL/ft²), you may need to compensate for excessive carryover by increasing the bleach-fix replenishment rate and the wash rate.

Agitation

The developer and bleach-fix recirculation rates for high-volume processors should be 0.20 to 0.35 tank volumes/minute. If the processor has multiple tanks, each tank should have this recirculation rate. Higher solution agitation may be needed for low-volume, slow-transport processors to maintain process activity.

The quality of agitation is important during the first few seconds of the bleach-fix step. If agitation is poor during this initial period, development may not be stopped effectively, which can cause magenta streaks and non-uniformity in the prints. This condition may be worse if the paper is inadequately squeegeed as it leaves the developer, permitting too much developer carryover into the bleach-fix.

Filtration

Processing solutions and wash waters may contain some insoluble materials. If you don't filter out these materials, they can stick to the paper, tank walls, rollers, and solution lines, and may damage the paper. Usually, filters with a porosity of 10 to 30 microns are effective for solutions and wash water. For incoming water supplies, use filters 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 (**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 weekly for developers and every two weeks for other solutions.

Replenishment Rates

The specified replenishment rates in Table 2-2 are starting-point recommendations. The actual rates depend on the type of processor, the amount of paper processed, and the rate of evaporation and oxidation. Replenishment 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/m² by the processor speed in m²/min (mL/ft² by the processor speed in ft²/min).

Avoid frequent adjustment of the replenishment rates. It is unlikely that you will see the effect of a rate change for some time, and the full effect will probably not be apparent for several weeks.

Table 2-2 Replenishment for Continuous Processors

Product	Replenishment for EDGE/ROYAL, ROYAL Luminous, Photo Book Papers mL/M ² (ML/ft ²)*	Replenishment for SUPRA VC, ULTRA, ULTRA HD, and Metallic VC Papers mL/M ² (ML/ft ²)*
EKTACOLOR RA Developer Replenisher	135 (12.5)	145 (13.5)
EKTACOLOR RA Developer Replenisher 12	118 (11)	131 (12.2)
EKTACOLOR RA Bleach-Fix Replenisher	215 (20)	215 (20)
EKTACOLOR RA Bleach-Fix Replenisher NR	54 (5)	54 (5)
Wash, number of tanks = 1†	10,800 (1,000) or higher	10,800 (1,000) or higher
Wash, number of tanks = 2	6,460 (600) or higher	6,460 (600) or higher
Wash, number of tanks = 3	4,300 (400) or higher	4,300 (400) or higher
Wash, number of tanks = 4	2,150 (200) or higher	2,150 (200) or higher

* Starting point rates only, exact rate dependent upon utilization and image content.

† Not recommended unless other modifications made to processor to limit bleach-fix carryover

Wash Rates

The final-wash flow rate depends on the number of wash tanks and the amount of paper being processed. Some processors automatically adjust the flow rate for the amount of paper being processed. If your processor does not adjust the water flow automatically, use a rate for the maximum paper width.

If your processor has only one wash tank, there will be little washing safety factor; therefore, to minimize the effect of bleach-fix carryover, use a wash rate of at least 10,800 mL/m² (1000 mL/ft²). You may also need to make other processor modifications to obtain adequate washing.

For multiple wash tanks, meter the wash water going into the wash tank closest to the dryer, and plumb the tanks so that the water cascades to the preceding tank in a countercurrent flow.

Low-Flow Wash—In high-volume processors with three or more wash tanks, use a low-flow wash after the bleach-fix. With a low-flow wash, you can recover silver that would otherwise be carried into the remaining wash tanks, where it is more difficult to recover. Using a low-flow wash keeps the silver concentrated so that it can be more efficiently recovered.

If your processor has four or more wash tanks, use two tanks for a low-flow countercurrent wash. If your processor has three wash tanks, use one tank for a low-flow wash.

Do not use a low-flow wash if your processor has fewer than three wash tanks. Replenish the low-flow wash at a rate of 215 mL/m² (20 mL/ft²). Use efficient squeegees at the exit of the last low-flow wash tank. If you do not regenerate the bleach-fix, combine the low-flow wash and bleach-fix overflows and recover silver from the mixture. If you regenerate the bleach-fix, do not mix the low-flow wash water with the bleach-fix overflow; recover silver from them separately. For more information on low-flow washes, see KODAK Publication No. J-212, *The Technology of Silver Recovery for Photographic Processing Facilities*.

Drying

The maximum drying temperature for KODAK EKTACOLOR Papers is 96°C (205°F).

Utilization and Maximum Weeks per Tank Turnover

Processor utilization determines which processing chemicals are best to use for your processor. Certain processing chemicals are designed to compensate for the higher rate of solution evaporation and oxidation that occurs in processors with low utilization.

A simple and convenient way to express processor utilization for continuous processors is “maximum weeks per tank turnover.” A tank turnover occurs whenever the volume of replenisher you have added equals the volume of the tank solution. It may take a few hours or several weeks to produce a tank turnover, depending on the volume of the tank, replenishment rate, and the amount of paper processed. To calculate the amount of time required for one tank turnover:

1. Determine the total solution volume of the developer tank if you don’t already know it.
2. Determine the weekly developer replenisher usage by keeping a record of the amount mixed and used, or by calculating the actual daily usage.
3. Divide the volume of replenisher used for one week (in litres) by the processor tank volume (in litres). The result is the number of weeks per tank turnover.

$$W = \frac{V}{R}$$

Where:

W = Weeks per tank turnover

V = Total volume of the developer tank solution

R = Total volume of developer replenisher used in one week

Table 2-1 lists the maximum number of weeks for a tank turnover for KODAK EKTACOLOR Chemicals that you can use for Process RA-4. To obtain the best performance from your processor, choose the chemical with the “Maximum-Weeks-per-Tank-Turnover” that best matches your processor’s level of utilization. Be sure to use a production period that is typical for your lab when you make the determination.

FOLLOW THESE RECOMMENDATIONS CAREFULLY

When you mix chemicals properly, you take the first step toward producing high-quality results consistently. You must then be sure to operate the processor at the recommended conditions. The most critical conditions are time, temperature, agitation, and replenishment. Check the processor regularly to be sure that it meets the specifications given in the tables in this section. When it is operating at the correct conditions, you’ll have less waste, less down time, higher productivity, and the best quality.

If you have any questions about how to set your processor for the conditions recommended, contact your Kodak sales representative, the equipment manufacturer, or call the Kodak Customer Assistance Team at 800-242-2424.

3 Using KODAK EKTACOLOR PRIME Chemicals in Minilabs

This section lists the recommended steps, conditions, and replenishment rates for minilab processors using Process RA-4. The chemicals necessary for your minilab will depend on the type of processor and your production volume. Kodak supplies EKTACOLOR PRIME Chemicals which are adaptable for use in most minilabs, and are available in sizes specially designed for minilabs. For a listing of available sizes, see Section 1, *KODAK EKTACOLOR Chemicals*. Use these chemicals for processing Kodak Color Papers designed for Process RA-4, such as:

- KODAK EKTACOLOR EDGE Paper
- KODAK ROYAL Digital Paper
- KODAK ROYAL Luminous Digital Paper
- KODAK Photo Book Paper
- KODAK PROFESSIONAL SUPRA ENDURA VC Digital Paper
- KODAK PROFESSIONAL ULTRA ENDURA Paper
- KODAK PROFESSIONAL ULTRA ENDURA High Definition Paper
- KODAK PROFESSIONAL ENDURA Metallic VC Paper

Note: For information on using KODAK SM Chemicals, see KODAK Publication No. Z-101, *Using KODAK SM Chemicals in SM Minilabs*.

For information on using KODAK EKTACOLOR Processing Cartridge 111, for use in all models of Fuji Frontiers, and some models of Noritsu Digital Minilab equipment, using Processes CP-48S and CP-49E, see KODAK Publication No. CIS-229, *Using the KODAK EKTACOLOR Processing Cartridge 111 with Digital Minilabs using Processes CP-48S and CP-49E*.

For information on using the KODAK EKTACOLOR Processing Cartridge 92/110 in a KODAK PROFESSIONAL RP 30 or SRP 30 Laser Printer, see Publication CIS-239, *Using the KODAK EKTACOLOR Processing Cartridge 92/110, CAT No. 1440775, for Professional Color Papers in KODAK PROFESSIONAL RP 30 and SRP 30 Laser Printers*.

Table 3-1 Processing Steps and Conditions for Process RA-4—Minilab Processors with Medium to High Production Volume

Solution/Step	Time* min:sec	Temperature °C (°F)
EKTACOLOR PRIME SP Developer Replenisher LORR	0:45	37.8 ± 0.3 (100.0 ± 0.5)
EKTACOLOR Developer Replenisher RT	0:45	35 ± 0.3 (95 ± 0.5)
EKTACOLOR PRIME SP Bleach-Fix and Replenisher LORR or EKTACOLOR Bleach-Fix and Replenisher	0:45	30 to 36 (86 to 97)
EKTACOLOR PRIME Stabilizer and Replenisher LORR†	1:30	30 to 37 (86 to 99)
Dry	As needed	Not over 96 (205)

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

† Use four countercurrent-flow stabilizer tanks with equal times in all tanks (0:23 in each tank). With three countercurrent-flow tanks, use a replenishment rate of 390 mL/m² (36 mL/ft²); with two countercurrent-flow tanks, use 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 and the wash time (see Section 2, *Wash Rates for Process RA-4*).

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 *Technical Publications* tab.

Kodak does not recommend processing 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.

Agitation

The recirculation rates for the developer and bleach-fix should be 0.50 to 0.75 tank volumes/minute. The recirculation rate for the stabilizer should be 0.67 to 1.0 tank volumes/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. Excessive developer carryover into the bleach-fix will aggravate this problem.

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, rollers, and lines, 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.

CHEMICAL OPTIONS FOR YOUR MINILAB

KODAK EKTACOLOR PRIME LORR Chemicals are supplied as a single-part concentrates for easy mixing, and recommended for minilabs with medium to high production volumes. The lower replenishment rates of PRIME Chemicals mean that waste-solution volume, packaging waste, and the need for solution mixing are all minimized. Most minilab equipment using Process RA-4 can use KODAK EKTACOLOR PRIME LORR Chemicals but the chemicals you will need and use will depend on the type of processor and your production volume. Minilabs operating in low utilization conditions may require other chemical choices.

Using Production Volume to Determine Chemical Choice

Choosing which chemicals are correct to use in your minilab is a simple exercise. 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.

To manage this impact, see *Periodic Low-Volume Situations* later in this section.

The table shows which developer and bleach-fix to choose based on the developer-tank volume and the number of 4 x 6-inch (10.2 x 15.2-cm) prints typically processed in a day.

Note: If your lab prints 3.5 x 5-inch (8.9 x 12.7-cm) prints, multiply the number of prints you make each day times 0.73 to convert them into 4 x 6-inch (10.2 x 15.2-cm) sized equivalent. Use that number to determine your developer.

Minilabs with Medium- to High-Production Volume

KODAK EKTACOLOR PRIME SP Developer Replenisher LORR

KODAK EKTACOLOR PRIME SP Bleach-Fix Replenisher LORR

KODAK EKTACOLOR PRIME Stabilizer Replenisher LORR

Minilabs with Very Low-Production Volume (or equipment with a roller-transport design)

KODAK EKTACOLOR RA Developer Replenisher RT (or EKTACOLOR PRIME Developer Replenisher LU in certain regions)

KODAK EKTACOLOR RA Bleach-Fix Replenisher

KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR

Table 3-2 Developer Options for Process RA-4

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
 Use EKTACOLOR RA Developer Replenisher RT

Replenishment Rates

The specified replenishment rates are starting-point recommendations. The actual rates depend on the type of processor, amount of paper processed, and other variables of the processing system. The rates are given in millilitres per square metre and in millilitres per square foot. To convert the rate to millilitres per minute, multiply the rate in mL/m² by the processor speed in m²/min (or mL/ft² by the processor speed in ft²/min).

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. Retained silver will be evident on KODAK Control Strips, Process RA-4, as a yellow patch that appears significantly brown. See your equipment manual for specifications and adjustments for squeegees or squeegee rollers.

Table 3-3 Replenishment for Minilabs

	Replenishment for EDGE, ROYAL, ROYAL Luminous, Photo Book Papers mL/M ² (mL/ft ²)*	Replenishment for SUPRA VC, ULTRA, ULTRA HD, MetallicVC mL/M ² (mL/ft ²)*
Products for Mid to High Utilization		
PRIME SP Developer Replenisher LORR	80 (7.5)	83 (7.7)
PRIME SP Bleach-Fix Replenisher LORR	54 (5)	54 (5)
PRIME SP Stabilizer and Replenisher LORR (4 tanks)	195 (18)	195 (18)
Products for Low Utilization		
EKTACOLOR Developer Replenisher RT	170 (15.8)	174 (16.2)
EKTACOLOR Bleach-Fix and Replenisher	215 (20)	215 (20)
PRIME Stabilizer and Replenisher LORR (4 tanks)	195 (18)†	195 (18)†

* Starting point rates only, exact rate dependant upon utilization and image content

† For three countercurrent-flow tanks, use a replenishment rate of 390 mL/m² (36 mL/ft²); with two countercurrent-flow tanks, use 780 mL/m² (72 mL/ft²).

Drying

The maximum drying temperature for KODAK EKTACOLOR EDGE and KODAK PROFESSIONAL SUPRA ENDURA Papers is 96°C (205°F).

Periodic Low-Volume Situations

From time to time, a minilab will experience low-volume periods. EKTACOLOR PRIME LORR Chemicals are tolerant of low-volume periods that last for four to eight weeks.

However, low-volume operation for longer periods may lead to unacceptable performance. We recommend using EKTACOLOR RA Developer Replenisher RT and EKTACOLOR Bleach-Fix Replenisher, which have higher replenishment rates, until production returns to normal.

To control the effects of low-volume processing, you can also take the steps described below.

When the number of prints processed is very low, you can observe two changes in process quality:

1. D-min, especially the yellow D-min, increases by as much as 6 density points.
2. The LD (Speed) or Black Patch (D-max) process-control parameter will fall below aim by as much as 10 density points.

Note: These conditions can also result from a processor malfunction—for example, if an air leak develops in the recirculation line or the replenishment rate is too low.

You can take a number of steps to minimize these conditions. Be sure to return to normal operation when production volume returns to normal.

- The yellow D-min increase described above is most commonly caused by the stabilizer solution. Replacing the stabilizer tank solution will reduce the yellow D-min. In many cases, changing only the first tank or the first two tanks will be sufficient. Routine dumping of the stabilizer every two to four weeks will minimize yellow D-min problems.
- If high yellow D-min persists, increase the replenishment rate for the EKTACOLOR PRIME Stabilizer LORR to reduce the problem. Increase the rate from 18 mL/ft² (195 mL/m²) to 23 mL/ft² (248 mL/m²) until production increases.
- When production volume is low, the LD speed parameter typically moves below aim. Small printer adjustments to maintain print density can accommodate minor shifts. However, if the low LD speed falls outside the lower action limit, you should increase the developer replenishment. Typically an increase from the nominal 7.5 mL/ft² (80 mL/m²) to 8.5 mL/ft² (91 mL/m²) will bring the process back into control. Also increase the bleach-fix rate to 6 mL/ft² (64 mL/m²).

Note: Before increasing the rates, verify that the processor meets specifications for replenisher delivery, solution time and solution temperature. Also check to be sure that the developer recirculation is working properly. For more information on operating a minilab at low utilization, see Publication CIS-246, *Operating Minilabs at Low Levels of Utilization: Process C-41 and Process RA-4*.

4 Using KODAK EKTACOLOR Chemicals in Roller-Transport Processors

This section lists the recommended steps, conditions, and replenishment rates for processing Kodak Color Papers and Display Materials in roller-transport processors using Process RA-4. KODAK EKTACOLOR RA Chemicals are designed for use with Process RA-4. Use these chemicals for processing the following color papers and materials designed for Process RA-4:

- KODAK PROFESSIONAL SUPRA ENDURA VC Digital Paper
- KODAK PROFESSIONAL ULTRA ENDURA Paper
- KODAK PROFESSIONAL ULTRA ENDURA High Definition Paper
- KODAK PROFESSIONAL ENDURA Metallic VC Paper
- KODAK PROFESSIONAL ENDURA Clear Display Material
- KODAK PROFESSIONAL ENDURA Transparency Display Material

Some processing options are available for Process RA-4; they are described in Section 6, *Processing Options with KODAK EKTACOLOR Chemicals*.

For information on mixing and handling EKTACOLOR RA Chemicals, see Section 1, *KODAK EKTACOLOR Chemicals*. For information on monitoring your process, see Section 6, *Process Monitoring and Troubleshooting with KODAK Control Strips, Process RA 4*.

For information on using the KODAK EKTACOLOR Processing Cartridge 92/110 in a KODAK PROFESSIONAL RP 30 or SRP 30 Laser Printer, see Publication CIS-239, *Using the KODAK EKTACOLOR Processing Cartridge 92/110, CAT No. 144 0775, for Professional Color Papers in KODAK PROFESSIONAL RP 30 and SRP 30 Laser Printers*.

For information on using KODAK EKTACOLOR Processing Cartridge 111, for use in all models of Fuji Frontiers, and some models of Noritsu Digital Minilab equipment, using Processes CP-48S and CP-49E, see KODAK Publication No. CIS-229, *Using the KODAK EKTACOLOR Processing Cartridge 111 with Digital Minilabs using Processes CP-48S and CP-49E*.

ROLLER-TRANSPORT PROCESSORS

Solutions in roller-transport processors are subject to increased oxidation and evaporation, because processor design and utilization rate differ from those of other types of processors. KODAK EKTACOLOR Developer Replenisher RT and KODAK EKTACOLOR Digital Developer Replenisher RT have been specifically formulated to reduce the effects of oxidation and evaporation.

KODAK EKTACOLOR Developer Replenisher RT is a robust performer in roller-transport processors, and can be used in a wide range of utilizations, from high utilization to low utilization. (See page 4-5 for Calculating Percent Utilization for your processor.) If your processor is operating in very low utilization conditions (less than 4%), you can further protect the developer from oxidation by adding EKTACOLOR RA Developer Additive (for further information, see EKTACOLOR RA Developer Additive, page 4-6).

Use KODAK EKTACOLOR Digital Developer Replenisher RT if you are processing primarily KODAK PROFESSIONAL ENDURA Display Materials, and your processor utilization is above 4%. This developer can also process any Kodak color negative paper as well, but it is specifically designed to yield higher D-max, higher contrast and saturation on display materials.

NOTE: You cannot use EKTACOLOR RA Developer Additive in KODAK EKTACOLOR Digital Developer Replenisher RT.

Do not use solutions intended for processors with higher utilization (i.e., KODAK EKTACOLOR RA Developer Replenisher or KODAK EKTACOLOR RA Bleach-Fix Replenisher NR) in roller-transport processors unless the utilization is at least 15 percent.

Steps and Conditions

Use the processing steps and conditions in Table 4-1 for processing KODAK Papers. See Table 4-2 for replenishment rates. To process KODAK PROFESSIONAL ENDURA Transparency and Clear Display Materials, use the steps and conditions in Table 4-3 and see Table 4-4 for replenishment rates.

Table 4-1 Processing Steps and Conditions for Process RA-4—Roller-Transport Processors

Solution/Step	Time* min:sec	Temperature °C (°F)	Comments
EKTACOLOR RA Developer Replenisher RT† or Digital Developer RT	0:45	35.0 ± 0.3‡ (95.0 ± 0.5)	Recirculate and filter. Use precise temperature control. Use squeegees at tank exit.
EKTACOLOR RA Bleach-Fix and Replenisher§	0:45	30 to 36 (86 to 96)	Recirculate and filter. Use squeegees at tank exit.
Wash¶	1:30	30 to 40 (86 to 104)	
Dry	As needed	Not over 96 (205)	

* Immersion time plus crossover time to the next tank. Developer time range is 44 to 48 seconds. Minimum times for other solutions can be one second less than the normal times. Longer than normal times should cause no adverse effect other than reducing the benefit of rapid access. For best results, use the recommended times with crossover times of 6 seconds or less. If the crossover time is longer than 6 seconds, the paper or material must be in the developer tank for at least 40 seconds.

† You can use EKTACOLOR RA Developer Replenisher in place of EKTACOLOR RA Developer Replenisher RT if your processor utilization is at least 15 percent.

‡ Check the developer temperature frequently with an accurate thermometer.

§ You can use EKTACOLOR RA Bleach-Fix and Replenisher NR if your processor utilization is at least 15 percent.

¶ Where water conservation is required, you can replace the wash with a stabilizer (see *Washless Option*).

Filtration

Processing solutions and wash waters may contain some insoluble materials. If you don't filter out these materials, they can stick to the paper, tank walls, rollers, and solution lines, and may damage the paper. Usually, filters with a porosity of 10 to 30 microns are effective for solutions and wash water. For incoming water supplies, use filters 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 (**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 weekly for developers and every two weeks for other solutions.

Replenishment Rates

The replenishment rates given in Table 4-2 are based on processor utilization; they are starting-point recommendations only. Actual rates depend on the type of processor, the paper or material processed, and the rate of evaporation and oxidation. If you process several products, use an average rate based on the product mix and adjust it as needed according to control-plot results. Avoid overcontrolling replenishment rates. Rate changes are likely to be small, and you may not see the full effect of changes for several weeks.

Table 4-2 Replenishment Rates for KODAK Papers

Product	Replenishment for EDGE/ROYAL, ROYAL Luminous, Photo Book Papers mL/M ² (ML/ft ²)*	Replenishment for SUPRA VC, ULTRA, ULTRA HD, and Metallic VC Papers mL/M ² (ML/ft ²)*
Developer Product		
EKTACOLOR RA Digital Developer RT	170 (15.8)	174 (16.2)
EKTACOLOR RA Developer Replenisher RT	170 (15.8) — above 7% utilization 205 (19) — 4 to 7% utilization	174 (16.2) — above 7% utilization 210 (19.5) — 4 to 7% utilization
EKTACOLOR RA Developer Replenisher RT (with Developer Additive, use below 4% utilization)	329 (30.6) — < 4% utilization†	339 (31.5) — < 4% utilization†
Bleach-Fix Product		
EKTACOLOR RA Bleach-Fix Replenisher	215 (20)	215 (20)
EKTACOLOR RA Bleach-Fix Replenisher (with Bleach-Fix Additive, use below 4% utilization)	323 (30)†	323 (30)†
EKTACOLOR RA Bleach-Fix Replenisher NR (utilization must be 15% and above to use NR)	54 (5)	54 (5)
Wash		
Wash, number of tanks = 1‡	10,800 (1,000) or higher	10,800 (1,000) or higher
Wash, number of tanks = 2	6,460 (600) or higher	6,460 (600) or higher
Wash, number of tanks = 3	4,300 (400) or higher	4,300 (400) or higher
Wash, number of tanks = 4	2,150 (200) or higher	2,150 (200) or higher
Washless Option		
PRIME Stabilizer and Replenisher LORR (4 tanks)§	195 (18)	195 (18)

* Starting point rates only, exact rate dependent upon utilization and image content.

† Increase replenishment rate as utilization goes down.

‡ Not recommended unless other modifications made to processor to limit bleach-fix carryover.

§ For three countercurrent-flow tanks, use a replenishment rate of 390 mL/m² (36 mL/ft²); with two countercurrent-flow tanks, use 780 mL/m² (72 mL/ft²).

Common Replenishment Systems—Some laboratories prefer to use a common replenishment system for continuous and roller-transport processors. The utilization of the roller-transport processor determines whether or not a common replenishment system is practical and the correct developer replenisher to use. Follow these guidelines:

If the roller-transport processor has—

- *Less than 4 percent utilization*

Do not use a common system, because you will need to add EKTACOLOR RA Developer Additive to the EKTACOLOR RA Developer Replenisher RT for additional protection from evaporation and oxidation.

Do not use developer that is treated with additive with continuous processors.

- *4 to 15 percent utilization*

Use KODAK EKTACOLOR RA Developer Replenisher RT and EKTACOLOR RA Bleach-Fix and Replenisher in *both* types of processors with the replenishment rates in Table 4-2.

- *Greater than 15 percent utilization*

Use KODAK EKTACOLOR RA Developer Replenisher and EKTACOLOR RA Bleach-Fix and Replenisher NR in *both* types of processors with the replenishment rates in Table 4-2.

Washless Option

If your water supply is limited, you can use KODAK EKTACOLOR PRIME Stabilizer and Replenisher LORR in place of a wash. Use temperature-controlled, countercurrent-flow, filtered tanks that have a recirculation rate of 0.40 to 0.65 tank volumes per minute. If the recirculation or replenishment rate is too low, biological growth and precipitates may form and require frequent solution changes and tank cleaning. The stabilizer time and temperature are the same as for wash water. The stabilizer replenishment rate depends on the number of tanks (see Table 4-2 and footnote). This information applies *only* to roller-transport processors.

PROCESSING KODAK PROFESSIONAL ENDURA TRANSPARENCY AND CLEAR DISPLAY MATERIALS

Although you can use the same processing chemicals for processing KODAK PROFESSIONAL ENDURA Transparency and ENDURA Clear Display Materials as for color papers, longer processing times and higher replenishment rates are required because these materials have thicker emulsions.

Table 4-3 gives the steps and conditions for processing these display materials in roller-transport processors using Process RA-4. You can also use these conditions to process display materials in continuous processors; however, they are usually processed in roller-transport processors because of the inconvenience of rethreading a continuous processor. See Tables 4-3 and 4-6 for replenishment rates for these materials in roller-transport processors.

Table 4-3 Processing Steps and Conditions for Process RA-4—KODAK PROFESSIONAL ENDURA Transparency and ENDURA Clear Display Materials

Solution/Step	Time* min:sec	Temperature† °C (°F)	Comments
EKTACOLOR RA Developer Replenisher RT	2:00‡	35.0 ± 0.3 (95.0 ± 0.5)	Recirculate and filter. Use precise temperature control. Use squeegees at tank exit.
EKTACOLOR RA Bleach-Fix and Replenisher§	2:00¶	30 to 36 (86 to 96)	Recirculate and filter. Use squeegees at tank exit.
Wash**	4:00¶	30 to 40 (86 to 104)	
Dry	As needed	Not over 96 (205)	

* Immersion time plus crossover time to the next tank.

† Check the developer temperature frequently with an accurate thermometer.

‡ Nominal developer time range is 1:49 to 1:58. For best results, do not use extended development times with ENDURA Display Materials.

§ **Do not** use EKTACOLOR RA Bleach-Fix and Replenisher NR with Display Materials.

¶ Minimum times for other solutions can be one second less than the normal times. Longer than normal times should cause no adverse effect other than reducing the benefits of rapid access. For best results, use the recommended times with a crossover time of 6 seconds or less.

** Where water conservation is required, you can replace the wash with a stabilizer (see *Washless Option*).

Table 4-4 Replenishment Rates for Display Materials

Product	Replenishment for ENDURA Transparency and Clear Display Materials mL/M ² (ML/ft ²)*
Developer Product	
EKTACOLOR RA Digital Developer RT	495 (46)
EKTACOLOR RA Developer Replenisher RT	495 (46) — above 7% utilization 581 (54) — 4 to 7% utilization
EKTACOLOR RA Developer Replenisher RT (with Developer Additive, use below 4% utilization)	861 (80) — < 4% utilization†
Bleach-Fix Product	
EKTACOLOR RA Bleach-Fix Replenisher	495 (46)
EKTACOLOR RA Bleach-Fix Replenisher (with Bleach-Fix Additive, use below 4% utilization)	754 (70)†
Wash	
Wash, number of tanks = 1	Not recommended
Wash, number of tanks = 2	6,460 (600) or higher
Wash, number of tanks = 3	4,300 (400) or higher
Wash, number of tanks = 4	2,150 (200) or higher
Washless Option	
PRIME Stabilizer and Replenisher LORR (4 tanks)‡	390 (36)

* Starting point rates only, exact rate dependent upon utilization and image content.

† Increase replenishment rate as utilization goes down.

‡ For three countercurrent-flow tanks, use a replenishment rate of 390 mL/m² (36 mL/ft²); with two countercurrent-flow tanks, use 780 mL/m² (72 mL/ft²).

LOW UTILIZATION

When a processor is used for a small percentage of its actual capacity, the processing solutions can be affected and yield less than optimum results. Percent utilization is a measure of how much of a processor's capacity is used. The utilization calculation for roller-transport processors compares the amount of paper or material that is actually processed to the maximum amount that could be processed at its full capacity. Percent utilization is the percentage of the capacity that is actually used.

Calculating Percent Utilization

Calculate the capacity of your roller-transport processor by first determining these four items:

1. Maximum width your processor can process in centimetres or inches.
2. Transport speed (m/min or ft/min). Determine this speed by measuring the amount of paper that travels by a given point in one minute.
3. The length of time (in hours) that the processor is up to temperature each day. Use the number of hours from the time the recirculation pumps and heaters are turned on to the time they are turned off.
4. Number of operating days per week.

When you have this information, use this formula to calculate the capacity in square metres per week:

$$C = \frac{W \times S \times 60 \times T \times D}{100}$$

Where:

- C = Capacity (in square metres per week)
- W = Width (in centimetres)
- S = Transport Speed (in metres per minute)
- T = Time processor is at process temperature each day (in hours)
- D = Number of days per week the lab normally operates

To calculate capacity in square feet per week, use this formula:

$$C = \frac{W \times (S \times 12) \times 60 \times T \times D}{144}$$

Where:

- C = Capacity (in square feet per week)
- W = Width (in inches)
- S = Transport Speed (in feet per minute)
- T = Time processor is at process temperature each day (in hours)
- D = Number of days per week the lab normally operates

Next calculate the total amount of paper and material actually processed by keeping a log. Each time paper or material is processed, note the date, time, and amount. For rolls, record the width and approximate length; for sheets, note the size (8 x 10 inch, 16 x 20 inch, etc.) and the number of sheets. At the end of the week, convert these figures to square metres or square feet by using the formulas below.

To calculate the total square metres in rolls of paper:

$$\frac{L1 \times W \times N}{100} = \text{total sq m}$$

To calculate the total square feet in rolls of paper:

$$\frac{L1 \times W \times N}{12} = \text{total sq ft}$$

To calculate the total square metres in sheets of paper:

$$\frac{L2 \times W \times N}{10,000} = \text{total sq m}$$

To calculate the total square feet in sheets of paper:

$$\frac{L2 \times W \times N}{144} = \text{total sq ft}$$

Where:

- L1 = Length of roll in metres (or feet)
- L2 = Length of a sheet in centimetres (or inches)
- W = Width of roll or sheet in centimetres (or inches)
- N = Number of rolls or sheets of a particular size

Add the total square metres (or square feet) of all paper and material processed for the week. To calculate the percent utilization, divide this figure by the figure you obtained for capacity according to the following formula:

$$U = \frac{P}{C} \times 100$$

Where:

- U = Percent utilization
- P = Amount of paper and material processed in one week (in square metres or square feet)
- C = Weekly capacity of processor (in square metres or square feet)

Compensating for Low Utilization

The amount of processor utilization affects process stability. Low utilization causes chemical changes in the solution through evaporation and oxidation. Increased replenishment can compensate for lower utilization up to a point; however, at extremely low utilization in roller-transport processors, additional protection is needed to maintain process stability. To obtain this additional protection, you can add KODAK EKTACOLOR RA Developer Additive to KODAK EKTACOLOR RA Developer Replenisher RT and KODAK EKTACOLOR RA Bleach-Fix Additive to EKTACOLOR RA Bleach-Fix and Replenisher. Add these chemicals *only* to replenisher solutions; *do not* add them to the tank solutions.

KODAK EKTACOLOR RA Developer Additive

If processor utilization is consistently less than 4 percent, use EKTACOLOR RA Developer Additive. When you mix this concentrate with EKTACOLOR RA Developer Replenisher RT, follow the instructions carefully. When you add the concentrate to the replenisher, you must also dilute the mix by adding more water. For example, if you use this additive to treat a 12 1/2-U.S. gallon (47 litre) mix of EKTACOLOR RA Developer Replenisher RT, you must bring the mix to a final volume of 15.6 gallons (59 litres)—instead of 12 1/2 gallons. Once you treat the EKTACOLOR RA Developer Replenisher RT with the developer additive, use only the replenishment rates given in Tables 4-2 for paper and 4-4 for display materials. *Do not* add this additive directly to the developer tank solution or use it with EKTACOLOR RA Developer Replenisher.

Note: You cannot use EKTACOLOR RA Developer Additive in KODAK EKTACOLOR Digital Developer Replenisher RT.

KODAK EKTACOLOR RA Bleach-Fix Additive

Mix EKTACOLOR RA Bleach-Fix and Replenisher according to the instructions packaged with the chemicals. If your processor utilization is consistently less than 4 percent, add KODAK EKTACOLOR RA Bleach-Fix Additive to the bleach-fix replenisher. *Do not* add any additional water to the bleach-fix replenisher when you use the additive. *Do not* add the bleach-fix additive *directly* to the bleach-fix tank solution. Use the amount of additive shown in Table 4-4. Use the replenishment rates given in Tables 4-2 for paper and 4-4 for display materials.

Table 4-5 Mixing Bleach-Fix Replenisher for Low-Utilization Processing

If Your Final Replenisher Volume is	Use This Amount of EKTACOLOR RA Bleach-Fix Additive
1 L	15.2 mL
10 L	152 mL
20 L	304 mL
25 gal (95 litres)	1440 mL

Other Adjustments for Evaporation and Oxidation

In addition to using additives in the developer and bleach-fix as part of your routine processing, you can make the following adjustments to compensate for evaporation and oxidation.

Bring Tank Solution Back to Level—When the tank level drops, it is usually because of evaporation, but first check that it was not caused by a leak. If the cause is not a leak, bring the tank to the proper level by adding water at the start of the processing day to keep the solutions from becoming too concentrated. Overconcentration affects developer and bleach reactions, and can cause process-control problems and excessive crystal formation on the tank walls and racks. At the end of each processing day, rinse the top rollers and sides of the racks and tanks with warm water.

Minimize Processor Operating Time—To reduce oxidation, minimize the amount of time that the processor is kept at operating temperature. Turn the processor off at the end of each work day and whenever you know that it will not be used for several hours during the day.

Turn Off the Transport Drive Except During Processing—To reduce oxidation further, turn off the transport drive except during processing. Install a standby switch that allows you to turn off the transport drive without shutting down the recirculation pumps and temperature control.

Use of Activated Carbon Filters to Remove Stain

In roller-transport and other processors, a build-up of oxidized chemicals in the developer tank solution can stain prints (typically yellow stain). To remove these oxidized chemicals and prevent staining, install an activated-carbon filter. You will see a significant stain reduction within 24 hours. The life of the filter cartridge depends on the amount of oxidation products that are treated and the size of the processor tank; however, typical length of use is about 14 days with a 75-litre (20-gallon) tank.

To reduce the possibility of contamination from the filter, pre-soak it in a small amount of developer replenisher for 24 hours before you install it. Discard the developer used for the pre-soak. You can use the following filters:

Filter	Manufacturer
Serfilco Filter Model No. SFC-10W-CARBO-FYNE	Serfilco, Inc. 2900 MacArthur Blvd. Northbrook, Illinois 60062-2005 (847) 509-2900 (800) 323-5431 www.serfilco.com
	Serfilco Europe Broadoak Industrial Park Ashburton Rd. West, Trafford Park Manchester, M17 1RW, England 44-(0)0161-872-1317 www.serfilco-europe.com
	Service Filtration of Canada. Ltd. 4141 Sladeview Crescent, Units 12&13 Mississauga, Ontario, L5L 5T1 Canada 905-820-4700 800-565-5278 (Canada only) www.service-filtration.com
Filter Micro-Carbon Model No. MGSWC4-93-710	Trumpler Clancy Inc. 75 Elmview Ave. Hamburg, New York 14075 (716) 649-9330 (888) 825-2629 www.trumplerclancy.com

5 Processing Options with KODAK EKTACOLOR Chemicals

Process RA-4 is versatile, especially when supported by KODAK EKTACOLOR Chemicals and Kodak expertise. You may be able to obtain additional environmental advantages by using the options described in this section:

- Developer regeneration
- Bleach-fix regeneration

REGENERATION AND REUSE OF KODAK EKTACOLOR RA DEVELOPER REPLENISHER 12

KODAK EKTACOLOR RA Developer Replenisher 12 is designed specifically for high-volume processors (i.e., at least one developer-tank turnover per week). To determine tank turnovers, see Section 2, *Using KODAK EKTACOLOR Chemicals in Continuous Processors*. You can regenerate EKTACOLOR RA Developer Replenisher 12 overflow with KODAK EKTACOLOR RA Developer Regenerator 12/55. With this regenerator, you do not need to treat the overflow with ion-exchange equipment.

Equipment and Chemicals

Developer regeneration with EKTACOLOR RA Developer Regenerator 12/55 requires very little capital expenditure for equipment. To regenerate developer, you will need the following equipment and chemicals:

- Collection tank for developer overflow
- pH meter that is reliable and accurate
- Buffers and reagents for pH meter adjustment and electrode storage
- KODAK EKTACOLOR RA Developer Regenerator 12/55
- A supply of KODAK EKTACOLOR RA Developer Replenisher 12, for times when there is not enough developer overflow to regenerate.
- Sulfuric acid (20-percent solution) for pH adjustment
- Potassium hydroxide (45-percent solution) for pH adjustment

Regeneration

The regeneration procedure is simple. You collect the overflow, and then add regenerator and water. An important final step is to check the pH of the regenerated replenisher, and adjust if necessary.

KODAK EKTACOLOR RA Developer Regenerator 12/55 is designed so that pH adjustment of the mixed replenisher does not need to be done routinely. However, in the event that pH adjustment is necessary, it typically requires a minimum amount of acid or base for pH adjustment. Sometimes this is necessary to compensate for minor differences between labs. It is likely that the amount of adjustment required in a particular lab will be consistent with each regenerated mix.

Be sure that your pH meter is well maintained and calibrated. Without reliable and accurate pH measurements, you will not be able to regenerate the solution properly and maintain developer activity. For information on using, maintaining, and calibrating a pH meter, see KODAK Publication CIS-121, *Measuring the pH of Photographic Processing Solutions*. Follow this method carefully to avoid errors in pH adjustment.

If the carryover of developer consistently exceeds 58 mL/m² (5.4 mL/ft²), you will need to add EKTACOLOR RA Developer Replenisher 12 periodically to restore the developer-system volume. To do this, keep in inventory a supply of KODAK EKTACOLOR RA Developer Replenisher 12. It is also recommended to keep enough KODAK EKTACOLOR RA Developer Replenisher 12 in inventory for emergency replacement of the developer tank solution.

To reduce the effects of oxidation and evaporation, use a floating lid on the storage tank and do not store more developer overflow than you can use within the recommended keeping time.

Use the following procedure to prepare replenisher with EKTACOLOR RA Developer 12 overflow, water, and EKTACOLOR RA Developer Regenerator 12/55:

1. Collect 312 litres (82.5 gallons) of EKTACOLOR RA Developer 12 tank overflow.
2. Add 66.2 litres (17.5 gallons) of water at 21 to 32°C (70 to 90°F).
3. Add the entire contents of Developer Regenerator 12/55 Part A, and stir for 2 minutes.
4. Add the entire contents of Part B, and stir for 2 minutes.
5. Add the entire contents of Part C.

6. Add water at 21 to 32°C (70 to 90°F) to bring the total volume to 568 litres (150 gallons), and stir until the solution is completely mixed.
7. Pass the regenerated replenisher through a filter (similar to that used in the developer recirculation system) when pumping it to the replenisher holding tank to remove any particulates.
8. Check the pH; if it is not within the range of 10.75 to 10.85 at 25°C (77°F), adjust it. Use a 45-percent potassium hydroxide solution to raise the pH; or a 20-percent sulfuric acid solution to lower the pH. Table 1 gives starting amounts of these solutions for pH adjustment. You may need to make more than one addition to adjust the replenisher to the correct pH range.

CAUTION: Potassium hydroxide and sulfuric acid require careful handling; they are strongly corrosive and can cause serious harm to the skin and eyes; they will damage clothing. For your safety, follow the directions in Appendix 2 and observe all caution statements.

9. Record the original pH, the amount of acid or base added, and the final pH. Use this record to monitor additions and to avoid errors. If you get a non-typical pH reading, check the calibration of your pH meter, and retest the pH.

Starting Amounts of Potassium Hydroxide and Sulfuric Acid for pH Adjustment

If the pH is *below* 10.75, add 45-percent potassium hydroxide (KOH) in the amounts shown in Table 5-1. If the pH is *above* 10.85, add 20-percent sulfuric acid in the amounts shown in Table 5-1.

Table 5-1 pH Adjustment

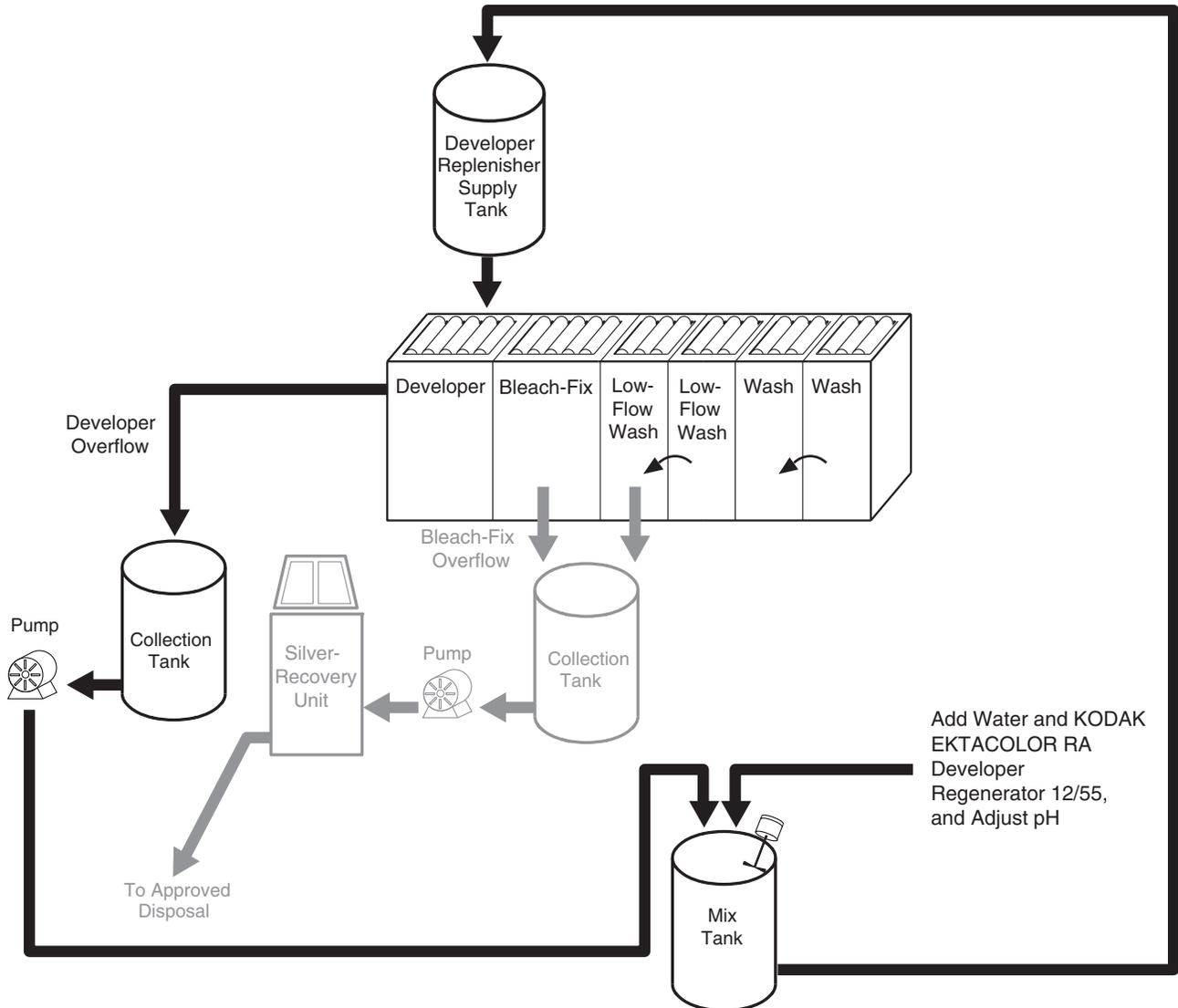
Starting pH	mL 45-Percent Potassium Hydroxide Addition (per 150 gallons)	Starting pH	mL 20-Percent Sulfuric Acid Addition (per 150 gallons)
10.74	174	10.86	264
10.73	200	10.87	306
10.72	230	10.88	350
10.71	260	10.89	394
10.70	288	10.90	438
10.69	316	10.91	482
10.68	345	10.92	526
10.67	373	10.93	570
10.66	402	10.94	614
10.65	432	10.95	658
10.64	460	10.96	702
10.63	489	10.97	746
10.62	518	10.98	790
10.61	546	10.99	834
10.60	576	11.00	876
10.59	604		
10.58	632		
10.57	662		
10.56	690		
10.55	718		
10.54	747		
10.53	776		
10.52	806		
10.51	834		
10.50	862		

Note: See Appendix 2 for directions to prepare solutions used to adjust pH.

Processing Conditions

Use the steps and conditions given for Process RA-4 (see Section 2, *Using KODAK EKTACOLOR Chemicals in Continuous Processors*). The replenishment rate for replenisher prepared from regenerated overflow is the same as for EKTACOLOR RA Developer Replenisher 12, (see Table 2-2, Section 2, *Using KODAK EKTACOLOR Chemicals in Continuous Processors*.)

Figure 5-1



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REGENERATING KODAK EKTACOLOR RA BLEACH-FIX

By regenerating bleach-fix for Process RA-4, you can reduce the bleach-fix contribution to BOD, COD, and iron in the processing effluent by approximately 40 percent. To regenerate the bleach-fix, collect the overflow, adjust the pH if required, desilver the solution with standard electrolytic recovery methods, and add KODAK EKTACOLOR RA Bleach-Fix Regenerator II.

An important step in regeneration is checking the pH of the bleach-fix overflow and regenerated replenisher, and adjusting if necessary. For information on using, maintaining, and calibrating a pH meter, see KODAK Publication CIS-121, *Measuring the pH of Photographic Processing Solutions*. Follow this method carefully to avoid errors in pH adjustment.

EQUIPMENT AND CHEMICALS

To regenerate your bleach-fix, you will need the following:

- Collection and storage tanks for the bleach-fix and low-flow-wash overflows
- Transfer pumps
- Plumbing to provide separate collection and desilvering of the low-flow wash
- Electrolytic silver-recovery cell capable of desilvering bleach fixes (see Appendix 1)
- KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Parts A and B.
- Means of accurately measuring pH

MODIFYING YOUR PROCESSOR

Use the standard processing steps and conditions for Process RA-4. Note that in Figure 5-2, the processor is shown with a single bleach-fix tank. While you can regenerate by using one tank of bleach-fix, optimum performance is obtained by using two countercurrent flow bleach-fix tanks in your processor. If your processor has more than one bleach-fix tank, plumb the tanks so that the overflow cascades into the preceding tank (countercurrent flow) and the replenisher feeds into the last tank. You'll need to configure the heating and pumping circulation lines to ensure that each tank is treated independently. Tanks cannot be cross-plumbed, which is the case with many processors.

Note: Countercurrent flow is different from the plumbing recommended for processors using KODAK EKTACOLOR RA Bleach-Fix NR. Do **not** use countercurrent flow with a non-regenerated system that uses Bleach-Fix NR; it can cause precipitate to form.

If necessary, install a separate recirculation, filter, and pump system for each bleach-fix tank. Install squeegees between tanks. When the bleach-fix tanks are set up with countercurrent flow, less silver will be lost to the wash.

If you cannot reconfigure the bleach-fix tanks on the processor as described above, it is possible to use KODAK EKTACOLOR RA Bleach-Fix Regenerator II with a single tank. However, the first bleach-fix tank will be at a lower pH than in a two-tank system, typically requiring a pH adjustment to the collected overflow prior to silver recovery.

If there is a low flow wash on the processor, you **must** provide for separate collection and desilvering of the low-flow wash. You can desilver the separate low-flow wash electrolytically or with chemical recovery cartridges. Hauling for off-site recovery may also be an option.

If you eliminate the low-flow wash, you will lose considerable silver to the final wash. However, you can recover silver from the final wash by using an ion-exchange method. For more information on the low-flow-wash setup and requirements, see KODAK Publication Nos. J-212, *The Technology of Silver Recovery for Photographic Processing Facilities*, or J-215, *Recovering Silver from Photographic Processing Solutions*.

STARTING UP A REGENERATED BLEACH FIX SYSTEM

To Prepare a Fresh Working Tank Solution

There are two methods to prepare a fresh working tank solution. The first method uses the EKTACOLOR RA Bleach-Fix Regenerator II concentrates. Mix according to the ratios in Table 5-2. Note the cautions for handling acids and bases described in Appendix 2.

Table 5-2 Preparing Fresh Tank Solution with KODAK EKTACOLOR RA Bleach-Fix Regenerator II

To Prepare 1 Litre of Fresh Tank Solution	
Start with water	737 mL
KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part A CAT 105 3131 or 895 5072	175.0 mL
KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part B CAT 105 0236 or 881 5680	76.0 mL
Adjust the pH to $7.0 \pm 0.25^*$	

* Use 28% ammonium hydroxide or 45% potassium hydroxide to increase pH.

Another method to prepare a fresh bleach-fix tank solution is by diluting KODAK EKTACOLOR RA Bleach-Fix Replenisher NR 1:1 with water. Adjust the pH close to 6.2 ± 0.25 with 28% ammonium hydroxide or 45% potassium hydroxide.

To Prepare a Fresh Replenisher Solution

There may be times when it will be necessary to prepare a fresh replenisher solution without regenerating existing tank solution. Mix according to the ratios in Table 5-3 that describes the mixing procedure.

Table 5-3 Preparing Fresh Replenisher Solution with KODAK EKTACOLOR RA Bleach-Fix Regenerator II

To Prepare 1 Litre of Fresh Replenisher Solution	
Start with water	698 mL
KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part A CAT 105 3131 or 895 5072	210 mL
KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part B CAT 105 0236 or 881 5680	92 mL
Adjust the pH to $7.0 \pm 0.25^*$	

* Use 28% ammonium hydroxide or 45% potassium hydroxide to increase pH.

Bleach-Fix Regeneration

Step 1: Collect the Bleach-Fix Overflow

Install plumbing to collect the overflow from the bleach-fix tank in your processor. If you have more than one processor using Process RA-4, you can collect the overflows in a common holding tank. Be sure that the holding tank is large enough to accommodate overflow during peak production periods and during downtime for maintenance and equipment repairs. Equip the collection tank with an overflow port to your lab's secondary silver-recovery system so that you can desilver excess solution before you discard it. Protect the solution from dirt and contamination by using a floating lid and a dust cover on the tank.

Step 2: Desilver the Bleach-Fix Overflow

Depending on processor configuration and the capacity of your silver-recovery cell, you may need to adjust the pH of the bleach-fix overflow to within the range of 7.5 to 8.0 before desilvering.

If the processor has two or more counter-current flow bleach-fix tanks, it is possible to run the system pH so that the overflow will be close to pH 7.5. At this pH and with a large-capacity silver-recovery cell, no pH adjustment is needed. If you operate a small-capacity silver-recovery system or have a single bleach-fix tank, the tank pH will be lower, around 7.0 to 7.25 and you will need to adjust the overflow to a pH of 7.5 - 8.0 for silver recovery.

If a pH adjustment is necessary for your system, you can pump the bleach-fix overflow to a mixing tank and adjust the pH there. Or you can pump the overflow to the recovery cell and add the alkali while the solution is recirculating.

Increase pH by adding 28-percent ammonium hydroxide or 45% potassium hydroxide. **Do not** use sodium hydroxide to adjust the pH of bleach-fix as it will cause formation of reddish-brown crystals in the solution.

When the overflow is within the range of pH 7.5 to 8, desilver the solution to a concentration of 1g/L. If you desilver to lower concentrations, poor plate quality will result. The desilvering time and current density will depend on laboratory conditions. See Appendix 1 to calculate starting-point conditions. You can adjust these conditions slightly if necessary.

It is important to maintain the pH of the system during desilvering. A pH below 7.5 will reduce the efficiency of the desilvering cell; it will take longer to reduce the silver concentration to 1.0 g/L. If the pH is too high, ammonia vapors will be released.

Step 3: Store the Desilvered Bleach-Fix Overflow

After you have desilvered the bleach-fix overflow, pump it to a storage tank for regeneration as soon as possible. Use a tank suitable for both peak production times and partial downtime. Equip the tank with a floating lid and dust cover.

The regenerator contains chemicals that protect the bleach-fix against oxidation. If you do not regenerate the bleach-fix within three days after it is desilvered, add 10 mL of 45 percent potassium sulfite or KODAK EKTACOLOR RA Bleach-Fix Additive (CAT No 803 6832) per litre of solution as a preservative.

A regenerated bleach-fix system eventually produces an excess volume of bleach-fix. Therefore, you will need to discard solution at some point. When you need to dispose of surplus volume, you can discharge the desilvered, unregenerated bleach-fix to a terminal silver-recovery system and/or haul it away for disposal.

Step 4: Regenerate the Desilvered Bleach-Fix Overflow

Use Table 5-4 for preparing regenerated replenisher.

For CAT Nos. 105 3131 and 105 0236

These catalog numbers come in flexible containers and make 100 gallons of regenerated replenisher. Add the full contents of KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Parts A and B, to the volume of overflow specified on the product label (91 gallons [344.5 L]). Stir until the solution is completely mixed.

For CAT Nos. 895 5072 and 8815680

These catalog numbers come in drums (55 gal) and are typically used with automatic mixing systems. For splitting directions for mixing replenisher, use the directions for preparing 1 litre of bleach-fix replenisher and multiply for the amount needed.

Table 5-4 Preparing Bleach-Fix Replenisher from Desilvered Overflow with KODAK EKTACOLOR RA Bleach-Fix Regenerator II

To Prepare 100 Gallons (378.5 Litres) (CATs 105 3131 and 105 0236)	To Prepare 1 Litre by Automixer (CATs 895 5072 and 881 5680)
Start with 91 gallons (344.5 litres) of desilvered bleach-fix overflow.	Start with 910 millilitres of desilvered bleach-fix overflow.
Add 5.12 gallons (1 container) KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part A.	Add 51.2 millilitres KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part A.
Add 3.2 gallons (1 container) KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part B.	Add 32.0 millilitres KODAK EKTACOLOR RA Bleach-Fix Regenerator II, Part B.
Add 0.68 gallon of fresh water to make 100 gallons.*	Add 6.8 millilitres of fresh water to make 1 litre.
Adjust the pH to 7.0 ± 0.25.	Adjust the pH to 7.0 ± 0.25.

* To lower the pH, add 78% acetic acid, or use EKTACOLOR RA Bleach-Fix and Replenisher NR, Part C. You can also use 20% sulfuric acid, but do not use concentrated sulfuric acid as it will immediately degrade the solution. For Automixers, if you find you need to make consistent adjustments to maintain the pH of the mixed replenisher, it is possible to add the amount of acid required into the water portion in the above table.

When mixing is completed and you have adjusted the pH, transfer the regenerated bleach-fix to the replenisher storage tank.

CONVERTING FROM ANOTHER BLEACH-FIX OR BLEACH-FIX REGENERATOR

To start using EKTACOLOR RA Beach-Fix Regenerator II without dumping existing tank solutions, follow the appropriate procedure below:

To Convert EKTACOLOR RA Bleach-Fix NR to a Regenerated System with EKTACOLOR RA Bleach-Fix Regenerator II

To convert without dumping the seasoned tank solution, prepare a fresh replenisher by diluting KODAK EKTACOLOR RA Bleach-Fix and Replenisher NR 1:1 with water. Adjust the pH to 7.0 with 28% ammonium hydroxide or 45% potassium hydroxide (See Appendix 2 for the preparation of hydroxide and acid solutions for pH adjustment.) Use this solution to replenish your present tank solution.

Desilver and clear the system of any combined bleach-fix and low-flow-wash overflows. Collect the bleach-fix and low-flow-wash overflows separately.

Desilver and regenerate the bleach-fix overflow as described under Starting Up a Regenerated Bleach-Fix System. Then replenish with the regenerated solution.

During the conversion, adjust the replenishment rate to 247 mL/m² (23 mL/ft²). This will provide a safety factor against retained silver. After a week or two of operation, adjust the rate to 215 mL/m² (20 mL/ft²).

Monitoring the Bleach-Fix Regeneration

Bleach-fix regeneration is more complex than most operations in a finishing lab. Any error left uncorrected is compounded over time in a regenerated system. However, if you mix all solutions correctly, desilver the overflow properly, replenish correctly, maintain the squeegees well, and carefully monitor and adjust the pH, the system should operate without problems.

Monitor the pH—

EKTACOLOR RA Bleach-Fix Regenerator II concentrates are designed to maintain the correct pH in a system that has efficient squeegees and is correctly replenished. It also has flexibility to allow adjustments of system pH to accommodate different processor configurations. The pH of the solutions has a great effect on bleaching performance and silver recovery efficiency. If squeegee efficiency varies, you will need to control the pH by direct pH adjustment or by changing the bleach-fix replenishment rate to maintain the pH. See Table 5-5 below for pH specifications.

Table 5-5

Solution		pH
Single Bleach-Fix Tank		7.0 to 7.3
2 Countercurrent Flow Tanks	Tank1	7.4 to 7.7
	Tank 2	7.0 ± .01
Regenerated Bleach-Fix Replenisher		7.0 ± .01

If the pH of the overflow does not lie within the specified ranges, check for several possible causes:

- Be sure that the pH meter is operating correctly. It may require recalibration, electrode replacement, or some other repair.
- Check the processor squeegees. Are they worn or out of adjustment?
- Check the bleach-fix replenishment rate. If the pH is low, you may need to reduce the replenishment rate. If the pH is high, you may need to increase the rate.

To monitor your bleach-fix system, keep a record of the pH of the bleach-fix during each stage of regeneration—the collected overflow, the desilvered overflow, the regenerated solution, and the pH-adjusted solution.

DIAGNOSING PROBLEMS

Retained Silver—High Black Patch density values and the visual appearance of the yellow Patch on the control strip are indications of a retained-silver problem. Compare the visual appearance of the Yellow Patch against the reference strip. If the Yellow patch on the processed control strip appears more brown, or "muddy," then retained silver is likely the cause. Also, prints that look desaturated in yellow and red colors are indicative of retained silver. Also, you can view the BP patch on the control strip with an infrared scope to check for retained silver. Retained silver is usually caused by too high a pH or dilution of the bleach-fix tank solution.

Underreplenishment, inefficient squeegees, or high replenisher pH may increase the pH of the bleach-fix tank solution. If the replenisher pH is correct, the most probable causes are excessive developer carried over into the bleach-fix tank or a bleach-fix replenishment rate that is too low. Check the condition of the squeegees before adjusting the replenishment rate.

Precipitates—Precipitates in the bleach-fix have three possible causes: incorrect pH adjustment (if needed) before desilvering, sodium compounds in the bleach-fix system, and overconcentration of a developer compound in the bleach-fix.

A *reddish-brown sludge* may indicate improper mixing of potassium or ammonium hydroxide with the bleach-fix overflow. These chemicals may be used to raise pH before desilvering. An incorrect mix ratio causes iron oxide to form.

Reddish-brown crystals are most often caused by using sodium compounds for pH adjustment (sodium hydroxide) or as a preservative (sodium sulfite). Correct the problem by switching to ammonium or potassium compounds.

A *white-yellow to gray precipitate* can form due to breakdown of the bleach-fix. This is primarily elemental sulphur, often accompanied by a noticeable odor of sulfur. The bleach-fix can breakdown due these causes:

- Low replenishment rate. Check to make sure replenishment rate is correct, and not set too low.
- Amperage too high during electrolytic cycle. Use Appendix 1 to calculate amperage and time for desilvering cycle. Also, check to make sure electrolytic unit is functioning properly.

A *purple precipitate* forming in the electrolytic cell tank above the solution level can be caused by one or a combination of these problems:

- Too much of developer is carried over into the bleach-fix. If this occurs, check and adjust the squeegee between the developer and the bleach-fix to reduce developer carryover into the bleach-fix.
- Too much solution foaming in the electrolytic cell tank. If foaming is excessive it can cause the purple precipitate to form in the foam, then adhere to the side of the tank. Check for loose fittings or pinhole leaks on the feed or recirculation lines of the electrolytic cell which could be introducing air into the solution. Or, make sure the feed and recirculation lines are plumbed so that bleach-fix is not "dropping" into the tank introducing air into solution to cause foaming.

Also, change the recirculation filters in the processor and the silver-recovery cell more often than normal until the problem is corrected

Long Desilvering Times

See Appendix 1, page 5-21 for calculating the average desilvering batch time. The calculations used in Appendix 1 are a guide only, and actual desilvering times can vary due to process variables. However, if your desilvering batch time is much longer than calculated, it could be caused by:

- **The bleach-fix overflow could be low in pH:** A pH of below 7.5 will cause the desilvering time to be longer. Adjust the overflow to be desilvered to a pH of 7.5 to 8.0.
- **The regenerated bleach-fix system may be too concentrated:** Bleach-fix solutions contain iron, which can compete with silver for the cell amperage. Therefore, the higher the concentration of the regenerated bleach-fix system, the longer the desilvering batch time. Over concentration can occur due to evaporation or poor water top-off procedures. In some cases, it can even occur due to extremely efficient squeegees limiting overflow into the bleach-fix. The concentration of the bleach-fix can be monitored by taking specific gravity reading with a hydrometer of the correct range.

Specific Gravity at 25°C (77°F)	
Tank 1	1.130 to 1.160
Replenisher*	1.130 to 1.150

* Tank 2 in countercurrent tank system same as replenisher

APPENDIX 1: DETERMINING OPTIMUM OPERATING CONDITIONS FOR BLEACH-FIX REGENERATION

To determine the optimum operating conditions for your laboratory, you'll need to gather data on lab capacity and needs. It is important to ensure that the capacity of the silver-recovery and regeneration system is significantly larger than the capacity of the processing equipment to generate bleach-fix overflow. This permits future expansion of business and allows for downtime due to equipment failure or scheduled maintenance.

You'll need the following data:

- Desilvering batch size. The physical size of the silver-recovery unit will usually determine batch size.
- Silver concentration in the overflow.
- Silver concentration after desilvering. The aim is approximately 1.0 g/L.
- Cathode surface area. The cathode is the removable electrode from the cell on which the silver plates. Measure the surface area of one side in square metres or square feet.
- Amount of paper processed per day in square metres.
- Theoretical current efficiency of the cell. This data is provided by the equipment supplier.

Bleach-Fix Volume/Batch Size

The volume of bleach-fix generated during a day will be-

$$\begin{aligned} &\text{Paper processed daily} \times \text{Replenishment rate in L/m}^2 \\ &\text{—or—} \\ &\text{m}^2 \text{ paper per day} \times 0.215 = \text{Litres of bleach-fix overflow} \end{aligned}$$

Most of the overflow is likely to be generated during an 8-hour period of the day, so collection tanks must be adequate to hold at least this volume.

Desilvering will be on a batch basis, and batch size will depend on the capacity of the cell. The desilvering of more than one batch during a 24-hour period may be possible. However, to match the desilvering and regeneration process to the processor capacity, we suggest using a cell that can handle the daily volume of bleach-fix overflow in 15 hours. This will provide flexibility for future expansion and for equipment downtime.

Plating Current

Electrolytically desilver the overflow to approximately 1.0 g/L silver. To obtain good plating, do not exceed a current density of 40 amps per square foot (431 amps per square metre) of the cathode area.

For example, if the cathode area is 3 square feet (0.279 square metre), the maximum plating current should not Exceed-

$$\begin{aligned} &40 \text{ amps per ft}^2 \times 3 \text{ ft}^2 = 120 \text{ amps} \\ &\text{—or—} \\ &431 \text{ amps/m}^2 \times 0.279 \text{ m}^2 = 120 \text{ amps} \end{aligned}$$

If the plating quality is poor (i.e., if it is very dark or soft, or contains silver sulfide precipitates), decreasing the current may improve plating. If you need more recovery capacity, you may be able to increase plating current by increasing the cathode area. For example, you may be able to install a larger cathode or modify a rotary cathode so that the silver will plate on both sides. See your equipment supplier about possible modifications.

Optional: When silver from the cathode(s) is removed, and the cathode(s) cleaned, try desilvering the next batch of bleach-fix overflow at a lower amperage (30 amps per ft²) for the first batch of overflow to insure silver is well adhered to cathode. Then for subsequent batches of bleach-fix overflow desilvered use the normal amperage of 40 amps per ft².

Desilvering Time

Use the following equation to estimate the electrolysis time required to recover silver from a particular batch size. Silver-recovery efficiencies of electrolytic units can vary considerably; use this calculation only as a guide.

$$T = \frac{(S - E) \times V}{A \times 4 \times N}$$

Where:

T = Hours required to desilver a batch of bleach-fix overflow

S = Starting silver concentration in g/L

E = Ending silver concentration in g/L

V = Batch size in litres

A = Amperage per hours through cell (Plating Current)

N = Theoretical current efficiency of cell expressed as a decimal (This value is supplied by the manufacturer. If it is not available, a value of 0.2 to 0.25 would be typical.)

Example:

To desilver a 380-litre batch of bleach-fix that has a starting concentration of 4.5 g/L to a final concentration of 1.0 g/L at 120 amps with a current efficiency of 20 percent, the time would be-

$$\frac{(4.5 - 1.0) \times 380}{120 \times 4 \times 0.2} = \text{Time (14 hours)}$$

Use KODAK Silver Estimating Test Papers to check the silver concentration. Do not try to reduce the silver concentration below 1.0 g/L; it will reduce silver-recovery efficiency and may cause poor plating. No silver is lost by maintaining the silver at 1.0 g/L, because it will be recycled into the bleach-fix replenisher.

APPENDIX 2: PREPARING SOLUTIONS FOR PH ADJUSTMENT

Note:

- Where possible, use commercially available 45% potassium hydroxide (KOH) from a vendor, so that mixing is not necessary and handling risks are minimized in the lab. Potassium hydroxide is often commercially available as a nominal 45- to 50-percent solution
- Where possible, use commercially available 20% sulfuric acid from a vendor, so that mixing is not necessary and handling risks are minimized in the lab.
- If ammonium hydroxide is for adjusting pH during bleach-fix regeneration, it is typically available as a nominal 28% solution.
- If acetic Acid is used for adjusting pH during bleach-fix regeneration, use commercially available 78% acetic acid from a vendor, or use EKTACOLOR RA Bleach-Fix and Replenisher NR, Part C.

To Prepare 45-Percent Potassium Hydroxide Solution

If you cannot obtain 45% potassium hydroxide solution from a vendor, mix as follows: Use commercial or reagent grade potassium hydroxide. To prepare 1 litre of 45% potassium hydroxide solution, carefully and slowly add 652 grams of Potassium Hydroxide to about 700 mls of water. Use cool water, and do not use a plastic vessel, use glass or stainless steel to dissolve the chemical as solution will get hot (exothermic reaction) and considerable heat may be released. Stir until mixed, then add additional water to bring total volume up to 1 liter, stir until completely mixed.

CAUTION: AMMONIUM HYDROXIDE AND POTASSIUM HYDROXIDE ARE STRONGLY CORROSIVE.

Ammonium hydroxide and potassium hydroxide require careful handling; they are strongly corrosive and can cause serious harm to skin and to eyes; they will damage clothing. Do not weigh these chemicals in an aluminum container. For your safety, follow these directions for preparing these chemicals for use in pH adjustment. Wear eye protection and avoid contact of the solid material or the solution with skin. See the Material Safety Data Sheet for handling and precautionary information. Observe all CAUTION statements. In the case of contact, follow the emergency procedure found in the MSDS.

To Prepare 20-Percent Sulfuric Acid

To prepare a 20-percent (7.2 N) solution of sulfuric acid, start with 4 parts of cold water. Stir the water, and slowly add 1 part concentrated (36 N) sulfuric acid. However do not use fuming sulfuric acid (40 N), because it is super-concentrated, very hazardous to handle, and more expensive. Always add the acid to the water; NEVER add the water to the acid.

CAUTION: SULFURIC ACID IS CORROSIVE.

Sulfuric acid requires careful handling; it is strongly corrosive and can cause serious harm to the skin and eyes; it will damage clothing. For your safety, follow these directions for preparing these chemicals for use in pH adjustment. See the Material Safety Data Sheet for handling and precautionary information. Observe all CAUTION statements. Avoid contact with skin or clothing by solution. Always use appropriate protective equipment including: gloves, goggles, and aprons to protect your eyes and skin.

For more information, see KODAK Publication J-98A, Safe Handling of Photographic Chemicals.

6 Process Monitoring and Troubleshooting with KODAK Control Strips, Process RA-4

To produce high-quality color prints consistently and with a minimum of waste, you need to match your process to a standard for density, color, and contrast each time you process paper. In addition to monitoring process parameters such as solution times, temperature, replenishment rates, solution concentrations, etc., you should regularly run control strips to ensure best results.

KODAK Control Strips, Process RA-4, for monitoring Process RA-4 are designed for use with KODAK EKTACOLOR EDGE Paper and KODAK ROYAL Digital Paper. KODAK Control Strips, Process RA-4, will detect process conditions that can degrade the quality of your finished prints.

Note: Kodak also produces control strips that are designed for use with KODAK PROFESSIONAL ENDURA Papers and Display Materials. KODAK PROFESSIONAL Pro Strips Color Negative Paper Control Strips / for Process RA-4 (CAT No. 129 8587) are better able to track the papers and the materials that are processed in professional finishing laboratories. Recommendations for using KODAK PROFESSIONAL Pro Strips are available in Section 8, *Process Monitoring and Troubleshooting with KODAK PROFESSIONAL Pro Strips Color Negative Paper Control Strips / for Process RA-4*.

This section describes standards and methods for setting up your process and for ongoing process monitoring. The primary “tools” for monitoring your process are the control strips and the reference strip. This section also describes how to use control strips and interpret the results. For the most up-to-date information, you can check the Kodak website, www.kodak.com/go/photochemicals.

Using KODAK Control Strips, Process RA-4, with KODAK EKTACOLOR EDGE Paper

KODAK Control Strips, Process RA-4 are made from KODAK EKTACOLOR EDGE Paper. The design of the paper makes it easy to maintain good process control and print quality. Because KODAK EKTACOLOR EDGE Paper is relatively insensitive to the formation of leuco-cyan dye, you will no longer need to consider leuco-cyan dye as a process problem. If your lab is processing KODAK PROFESSIONAL ENDURA Papers and Display Materials, you should consider converting to KODAK PROFESSIONAL Pro Strips so that you can monitor those materials for leuco-cyan dye.

KODAK EKTACOLOR EDGE Paper is designed so that a visually neutral patch, e.g., the LD patch on the control strip, will have approximately balanced red, green, and blue densities when measured with densitometers that conform to ANSI Status A responses. Some densitometers that do not

conform to ANSI Status A responses may yield non-matched red, green, and blue density readings for a visually neutral patch on these papers. This will not cause problems with print quality, because each control strip is compared with a reference strip to determine the control values, and any bias from the densitometer will be cancelled out.

For more information, visit our website at www.kodak.com/go/photochemicals.

PROCESS-MONITORING TERMS

The following terms are commonly used in process monitoring:

Action Limits—The action limits are the boundaries of the aim operating range of the process. As long as the control-strip 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 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—You compare your control-strip density readings to these values. To obtain aim values, read the reference-strip densities; then apply the correction factors (supplied with the control strips and reference strip) to those density readings. Enter the aim values in the spaces provided on the left side of your control chart.

Control Limits—The control limits define the maximum tolerances that are acceptable for processing customer work. If any density value of your process plots beyond the control limit, the process is out of control. Results will be unsatisfactory for color, density, and/or contrast. When any density value plots beyond the control limits, stop processing customer work until you find the cause of the shift and correct it.

Control Strips—These are precisely exposed strips 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 batch (code number) of control strips.

Reference Strip—This is a control strip that has been precisely exposed and processed by Kodak under 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. The tolerances and limits for KODAK Control Strips, Process RA-4, are listed in the table below.

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

KODAK CONTROL STRIPS, PROCESS RA-4

The Basic Control Material

These strips are available in boxes of ten moisture-resistant 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 particular batch. Each box contains correction factors for that particular code number. Use these correction factors to calculate the aim values for each batch of strips.

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

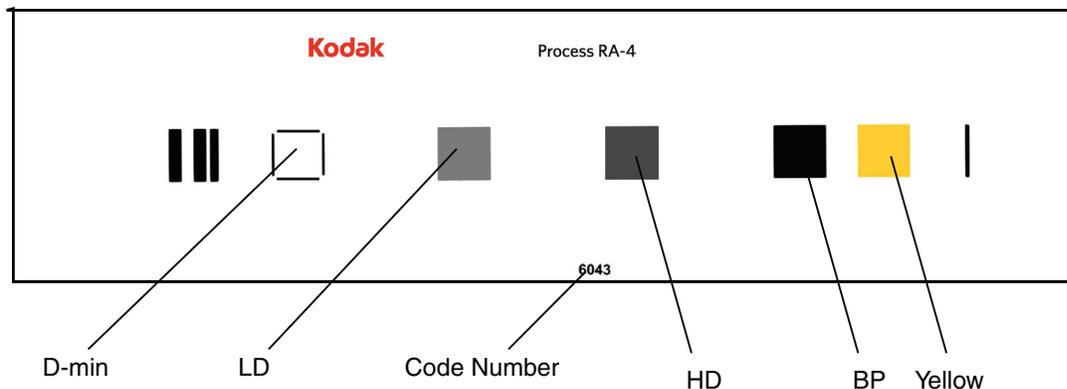
Storing and Handling Control Strips

Store unused control strips 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; then reseal and return the package to the freezer as quickly as possible. **Do not** keep the package out of the freezer for more than one hour per day.

Store your daily supply of control strips in a lighttight container at room temperature. Be sure to allow the strips to reach room temperature before you process them. Handle control strips by the edges to prevent fingerprints and surface damage.

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

Figure 6-1



Starting Out

To begin process monitoring, you will need—

- KODAK Control Strips, Process RA-4
- An electronic densitometer equipped with Status A filters
- KODAK Process Record Form, KODAK Publication No. Y-55, or similar graph paper. (A blank Y-55 is available at www.kodak.com/go/retailerresources.)
- Red, green, and blue pencils

You can also use KODALINK Service Software to easily read, plot and store your results. One of the many advantages of this system is that all calculations around setting the aim and plotting the measurement results are done by the system, including automatic application of control strip correction factors. For more information about this system, contact your Kodak representative or distributor.

Processing Control Strips

Each time you process a control strip, position it in the same location in your processor. Follow this schedule for processing a control strip:

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

Plotting Control-Strip Densities

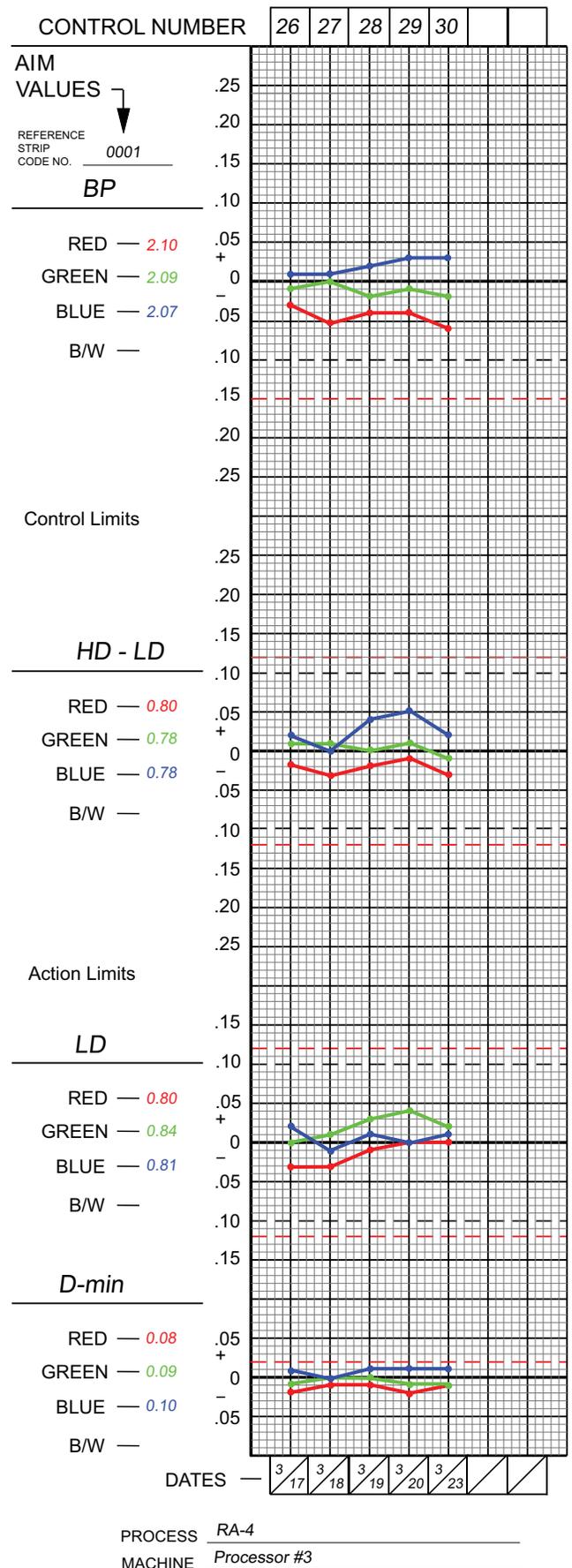
You may choose to make a control chart by using the KODAK Process Record Form Y-55 or similar graph paper (see the example in Figure 6-2). Then follow the procedure below:

1. Draw in the action and control limits given in Table 6-1. Use black for the action limits and red for the control limits.
2. Remove the reference strip from the box of control strips.

IMPORTANT: 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 to return the readings to normal values.

3. Use a precision electronic densitometer to measure the Status A red, green, and blue densities in the center of the D-min, LD, HD, and BP patches of 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. 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, the reference strip, and the control strips identifies each batch.

Figure 6-2



- To calculate aim values, apply the correction factors supplied in the instruction sheet packaged with the 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.

- Process a control strip and measure the same patches that you measured in step 3.
- Calculate the variations from aim by subtracting the aim densities from your control-strip densities. Plot the variations on your control chart.
 - Plot differences that are **larger** than the corresponding aim values (+ values) **above** the aim line.
 - Plot differences that are **smaller** than the aim values (– values) **below** the aim line.
- If any of the variations from aim plot 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. The *DIAGNOSTIC CHARTS* and the *CONTROL-CHART EXAMPLES* will help you troubleshoot process problems.
- Whenever you take corrective action, process another control strip to confirm that the process is in control before you resume normal processing.

Changing to a New Batch of Control Strips

When you change from your current batch of control strips to strips with a different code number, make a crossover to confirm that both batches (code numbers) will provide the same information. *Be sure that your process is stable and in control before you begin using a new batch of control strips.*

- While you still have a week's supply of control strips of the current code, process one control strip from the new batch of strips with one strip from the current batch in *three separate runs*.
- Read and record the densities of the processed strips.
- Determine aim values for the new batch of control strips; follow steps 2 through 4 under *Processing Control Strips*.
- For your current batch of control strips, calculate the variations from aim by subtracting your current aim densities from the densities of the three strips. Plot the variations on your control chart.
- For the new batch of strips, calculate the variations from aim by subtracting the new aim densities (calculated in step 3) from the densities of the three strips. Plot the variations on your control chart.

- Calculate the differences between the variations from aim of the current strips and the new strips. Average these differences; then divide the result by 2.
- Add or subtract the results from step 6 from the aim values for the new batch of strips determined in step 3. The amount of the adjustment should not exceed the aim-value adjustment tolerances given in the table on page 2. If the adjustment is greater than the tolerance, determine the cause. Check your calculations, densitometer, and control strips.
- Record the new aim values and the code number of the new batch of strips on your control chart, and begin using the new batch of strips.

Mathematical Crossover Procedure

After you have mastered the crossover method described in the previous section, you may want to use a mathematical method. It requires no plotting or subtracting of negative numbers, and no side calculations of deviations or averages. You can use longhand arithmetic or a calculator. Follow the list of calculations shown in the table below. An example is given to help you. You may also want to make copies of the table and use them as worksheets.

Calculation	Example Red LD	Red	Green	Blue
Current reference value	0.52			
+ New initial reference value	+0.55	+	+	+
Equals	1.07			
x 3	x 3	x 3	x 3	x 3
Equals	3.21			
+ New strips	+ 0.54	+	+	+
	+ 0.55	+	+	+
	+ 0.56	+	+	+
- Current strips	- 0.55	-	-	-
	- 0.52	-	-	-
	- 0.56	-	-	-
Equals	3.23			
÷ 6	÷ 6	÷ 6	÷ 6	÷ 6
Equals	0.538			
New adjusted* reference value (rounded up)	0.54			

*The difference between the new adjusted reference value and the new initial reference value should not exceed the aim-value adjustment tolerance.

INTERPRETING YOUR CONTROL PLOT

Your control plot provides a running record of your process. It will show how consistent your process is, and how well it meets your aim. It provides you with helpful information for analyzing and correcting process problems. Your process will produce acceptable results if your control strips plot within the control limits.

Corrective Action

When one or more process parameters exceed the control limits, stop processing customer work until you find the cause of the problem and correct it. It is important to become familiar with control-chart patterns and cause-and-effect relationships. Control-chart patterns can generally be separated into three categories: high activity, low activity, and high D-min. Also, you can check your control chart to determine if the process drifted out of control slowly or changed suddenly.

High Activity

The process is out of control with process parameters plotting above aim. This condition can be caused by—

- Developer temperature that is too high
- Developer time that is too long
- Overreplenished developer (i.e., the solution is replenished at a rate that is too high)
- Mixing error
- Developer contamination

Low Activity

The process is out of control with process parameters plotting below aim. This condition can be caused by—

- Developer temperature that is too low
- Developer time that is too short
- Underreplenished developer (i.e., the solution is replenished at a rate that is too low)
- Mixing error
- Developer tank solution diluted with water
- Developer contamination

High D-min

This condition can be caused by—

- Developer oxidation resulting from low utilization
- Developer contamination
- Weak or oxidized, sulfurized bleach-fix
- Dirty stabilizer, or heavy dirt build up on wash racks/rollers

Trend

A trend shows an out-of-control condition that has occurred slowly over time. It indicates a problem such as—

Improper replenishment—Check that the replenishment rate is correct and that the replenishment system is operating properly. Also check for improperly mixed replenisher.

Evaporation or oxidation—Check for low utilization or air drawn into the processing solutions by a bad pump, a recirculation system leak, or a poorly placed ventilation fan.

Contamination—Check for photographically active materials that are leaching slowly into the solutions. The contaminants may come from anything that is in contact with the solutions, such as filters, plumbing, etc.

Incorrect mixing—Check for mixing errors caused by improper measurement, improper calibration of mixing tanks, etc. If you suspect that the problem was caused by incorrectly mixed replenisher solution, mix a new batch of replenisher to see if a fresh mix gradually corrects the problem.

Sudden Change

This is an out-of-control condition that occurs *suddenly*. It *usually* indicates a problem with—

Control strips—Check that you used control strips of the same code number. Remember, if you change code numbers, you need to establish new aim values for the new batch (see *Changing to a New Batch of Control Strips*). Check that the control-strip code numbers match those of the reference strip. Check that the strips were handled and stored properly.

Densitometer—If your densitometer is not working properly or is out of calibration, the density readings will be wrong. This can falsely signal a process change. Check that you used Status A filters.

Time or temperature—Check that the time and temperature are set correctly, particularly if they are easy to change accidentally.

Contamination—Bleach-fix splashed into the developer during rack cleaning or clearing a paper jam can cause sudden large spreads in your control plots.

Solution mixing—If the sudden change occurs after you have mixed a fresh tank solution, check that it was mixed correctly.

Aim values—Check that you compared the control-strip densities with the correct aim values.

Note: When you troubleshoot a problem, check the easiest and most obvious causes first; then check the more difficult and less likely causes.

How Each Processing Solution Affects Your Results

Each solution in Process RA-4 has a specific function. Operational errors involving each solution will affect process performance differently. When you understand the reaction of each solution, you can better diagnose processing problems.

Developer

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

The amount of cyan, magenta, and yellow dye formed depends on exposure and developer activity. Temperature, time, replenishment rate, replenisher concentration, 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-Fix

The 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 halide.

Bleach-fix performance depends on the concentration and the diffusion rate of the solution into the emulsion. Time, agitation, and temperature affect the diffusion rate. Incorrect bleach-fix conditions or an abnormal bleach-fix can affect the amount of dye formed.

Inadequate bleach-fixing may not convert all of the metallic silver to silver halide. A sign of retained silver is an increase in the black-patch (BP) densities of the control strip and a desaturation of the yellow patch on the control strip. Retained silver degrades image quality by desaturating the colors and is especially apparent when the yellow patch appears brown. It has a greater effect on higher-density areas, which contain more metallic silver. You can remove retained silver by reprocessing the paper or material in a good bleach-fix.

Wash

Washing removes residual chemicals from the paper. If the chemicals are not removed, they can degrade the image and cause the dye to fade. 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 can enter the emulsion to remove the chemicals, but not so warm that it damages the emulsion. For more information on washing, see Section 2, *Using KODAK EKTACOLOR Chemicals in Continuous Processors*.

Stabilizer

Washless (non-plumbed) minilabs use a stabilizer instead of a wash step. An optional cycle for roller-transport processors also uses a stabilizer to conserve water. The stabilizer removes residual chemicals from the paper.

Checking Prints for Retained Silver

Inadequate bleach-fixing can lead to retained silver in prints. High levels of retained silver affect print quality and can also give false signals to sensors used in automatic print choppers.

Inadequate bleach-fixing is caused by dilute or underreplenished bleach-fix, a short bleach-fix time, or a low temperature (or a combination of these conditions). The most common cause is dilution of the bleach-fix due to ineffective developer squeegees and excessive developer carryover.

To check prints for retained silver, compare the processed control strip with the reference strip by using an infrared scope in a darkroom. When you view the control strip through the scope, the dye image will appear nearly invisible. If your process does not have a retained-silver problem, the reference strip and your control strip should look the same. If the process does have a retained-silver problem, the silver image in the control strip will be visible as a darker density, most evident in the black patch.

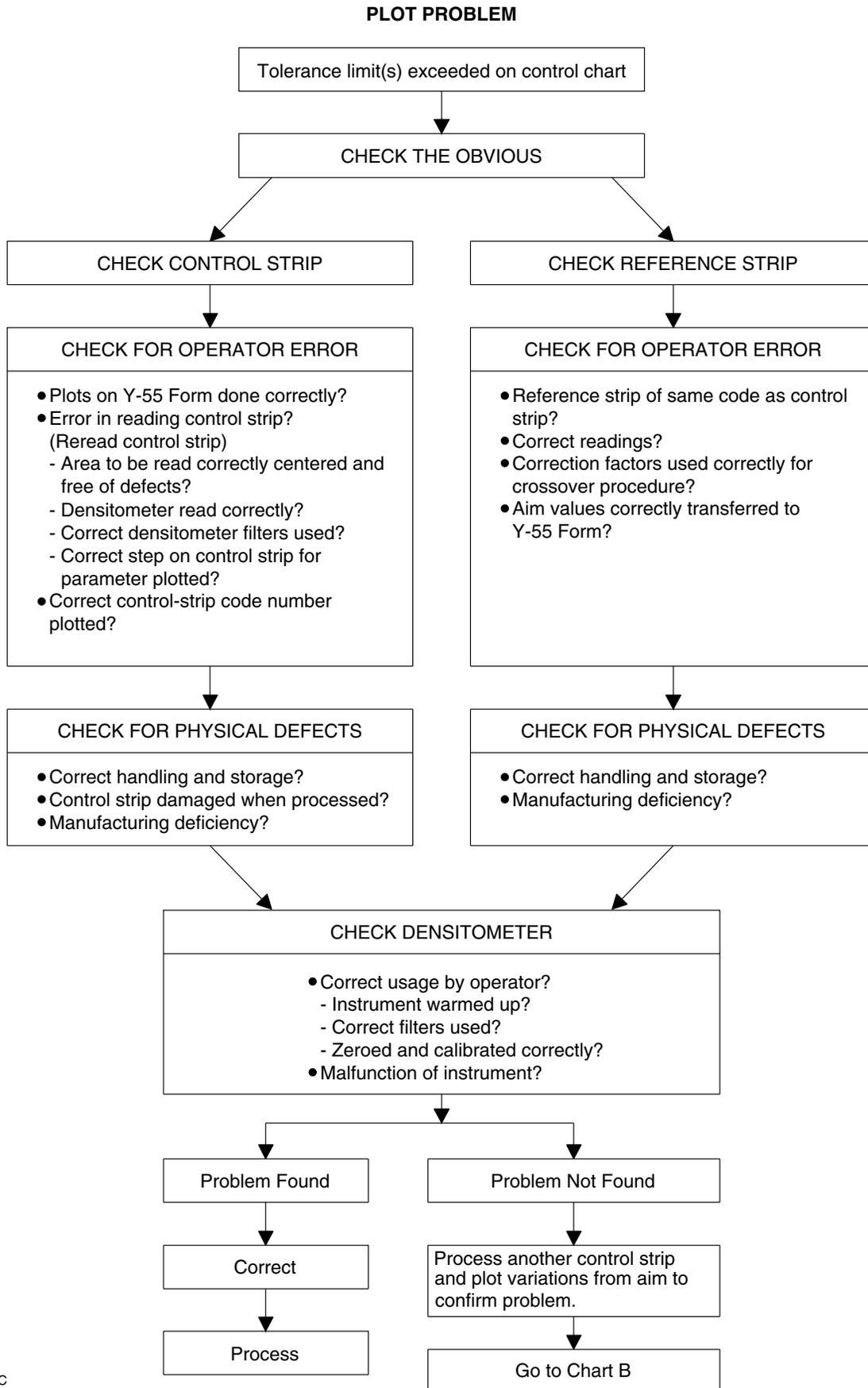
Infrared scopes are available from several sources; check the yellow pages of your telephone directory under *Scientific Apparatus and Instruments*.

DIAGNOSTIC CHARTS

The diagrams in this section provide you with a step-by-step approach to diagnosing process problems. The preliminary and summary charts show which detailed chart to check for your problem. The charts give probable causes and suggest corrective actions.

Chart	Title
A	Preliminary
B	Summary—Control-Chart Plots
C	Control-Chart Plots—High BP, HD-LD, or LD
D	Control-Chart Plots—Low BP, HD-LD, or LD
E	Control-Chart Plots—High D-min
F	Control-Chart Plots—Visual Appearance—Developer and Bleach-Fix
G	Control-Chart Plots—Visual Appearance of Paper
H	Control-Chart Plots—Visual Appearance of Paper
I	Control-Chart Plots—Visual Appearance of Paper

**Chart A
Preliminary**



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Chart B Summary—Control-Chart Plots

DESCRIBE PLOT PATTERN

FURTHER IDENTIFY AND GO TO SPECIFIED CHART

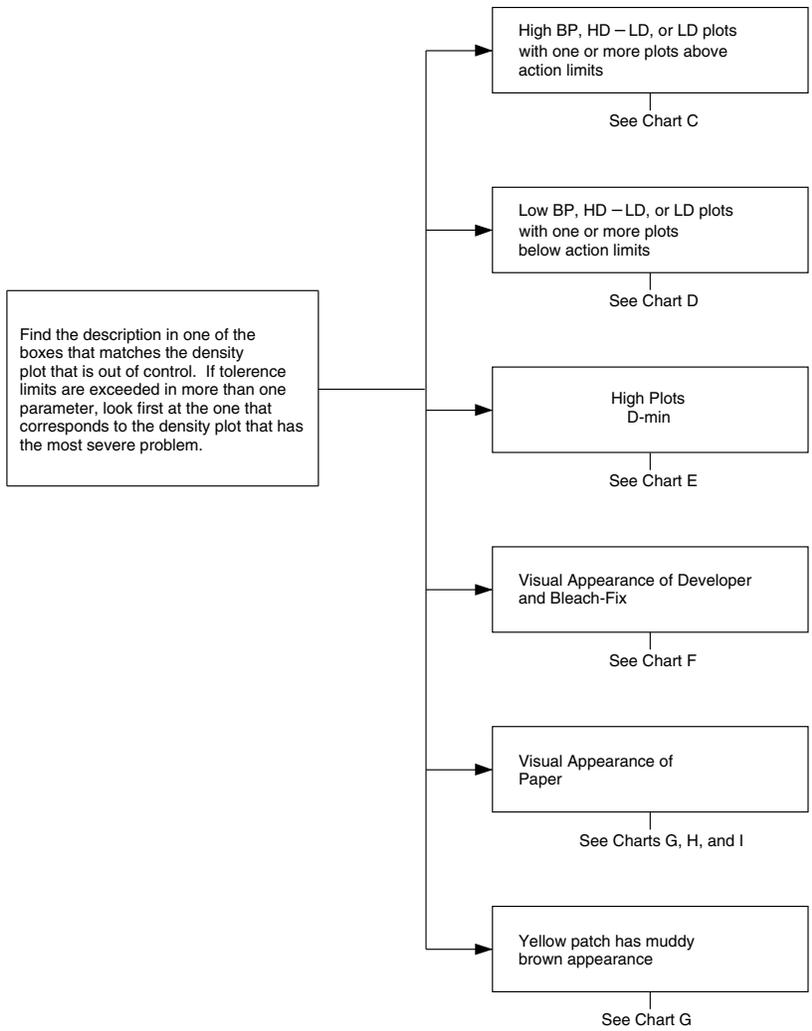
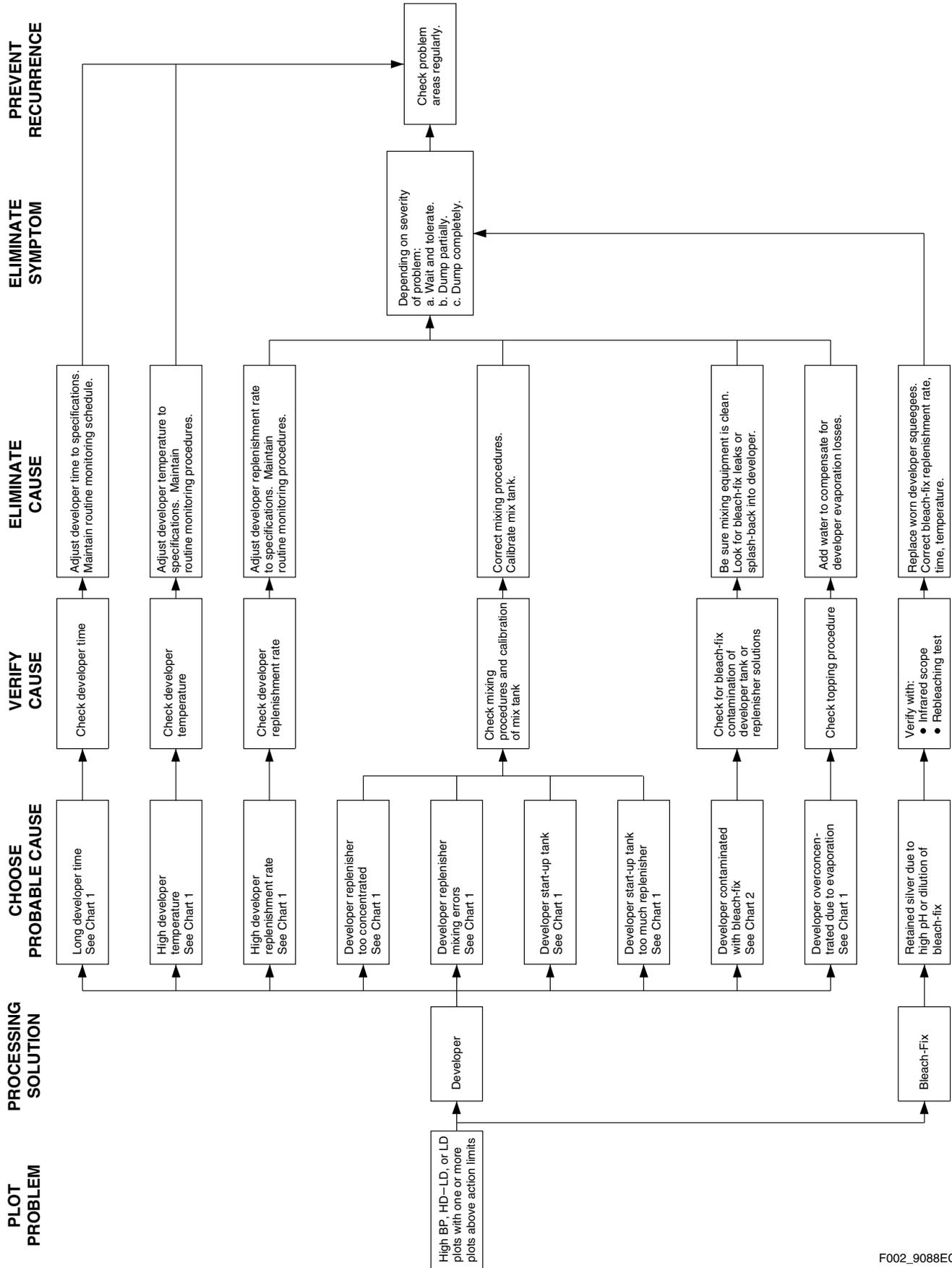
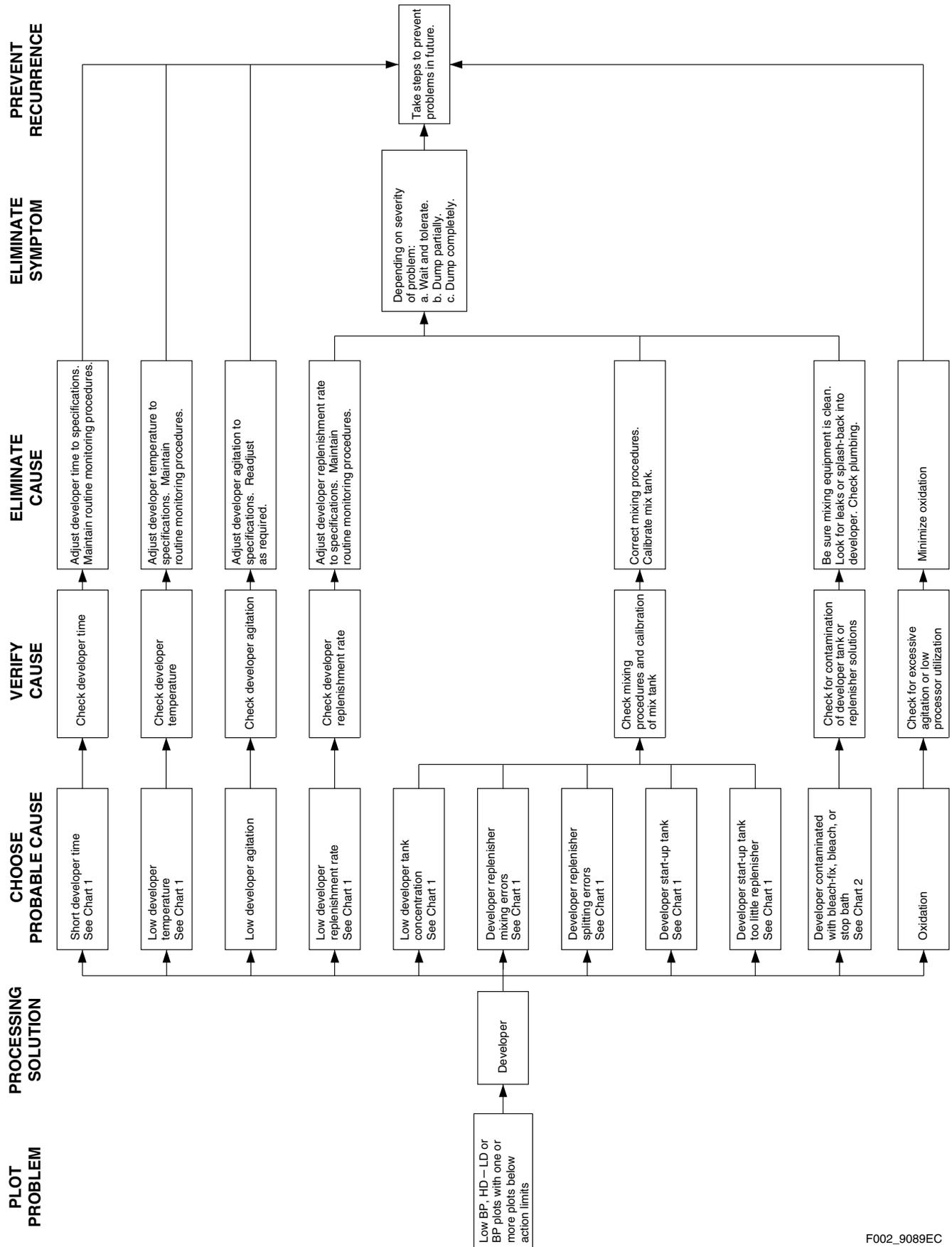


Chart C
Control-Chart Plots—High BP, HD – LD or LD



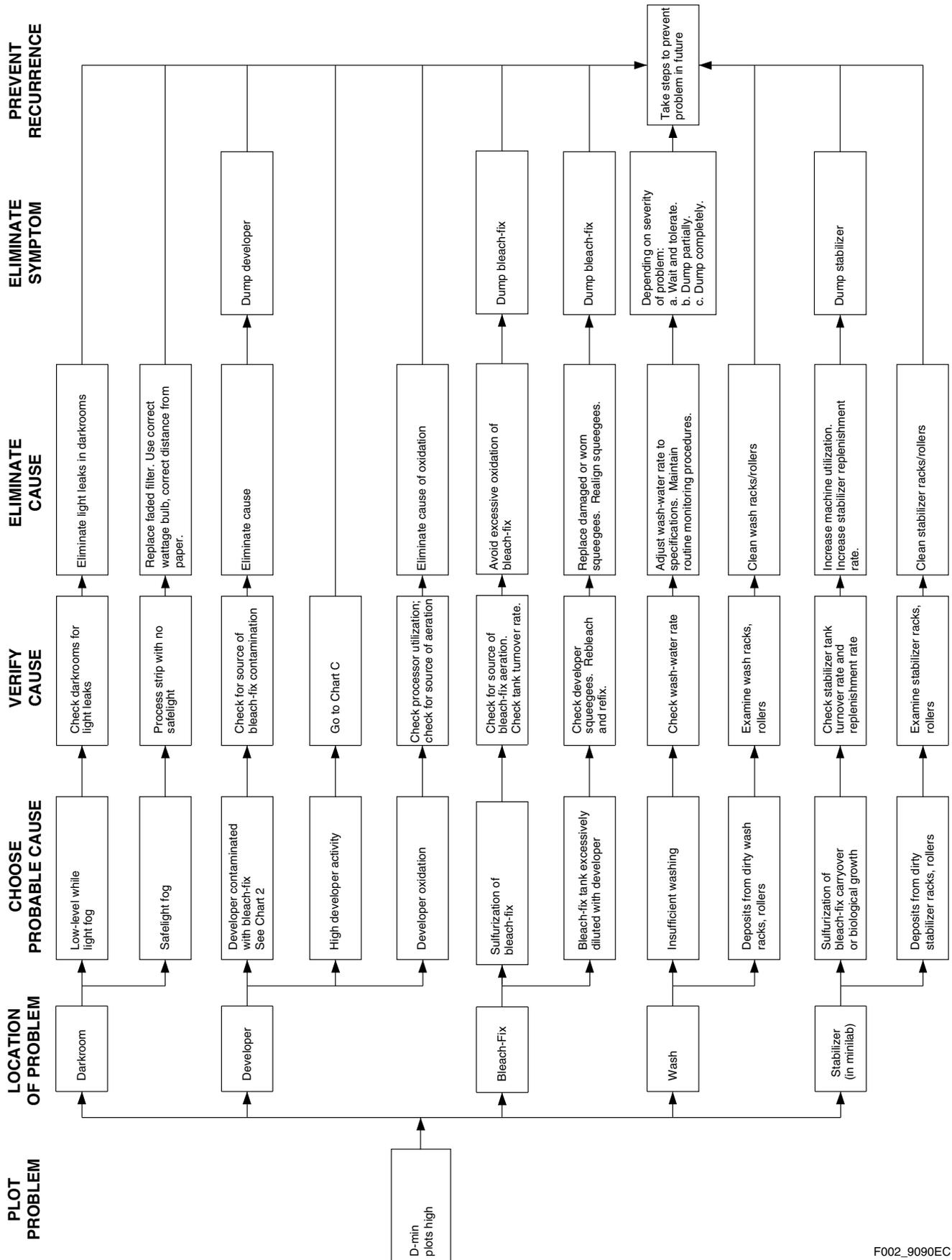
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Chart D
Control-Chart Plots—Low BP, HD – LD or LD



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Chart E
Control-Chart Plots—High D-min



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Chart F
Control-Chart Plots—Visual Appearance – Developer and Bleach-Fix

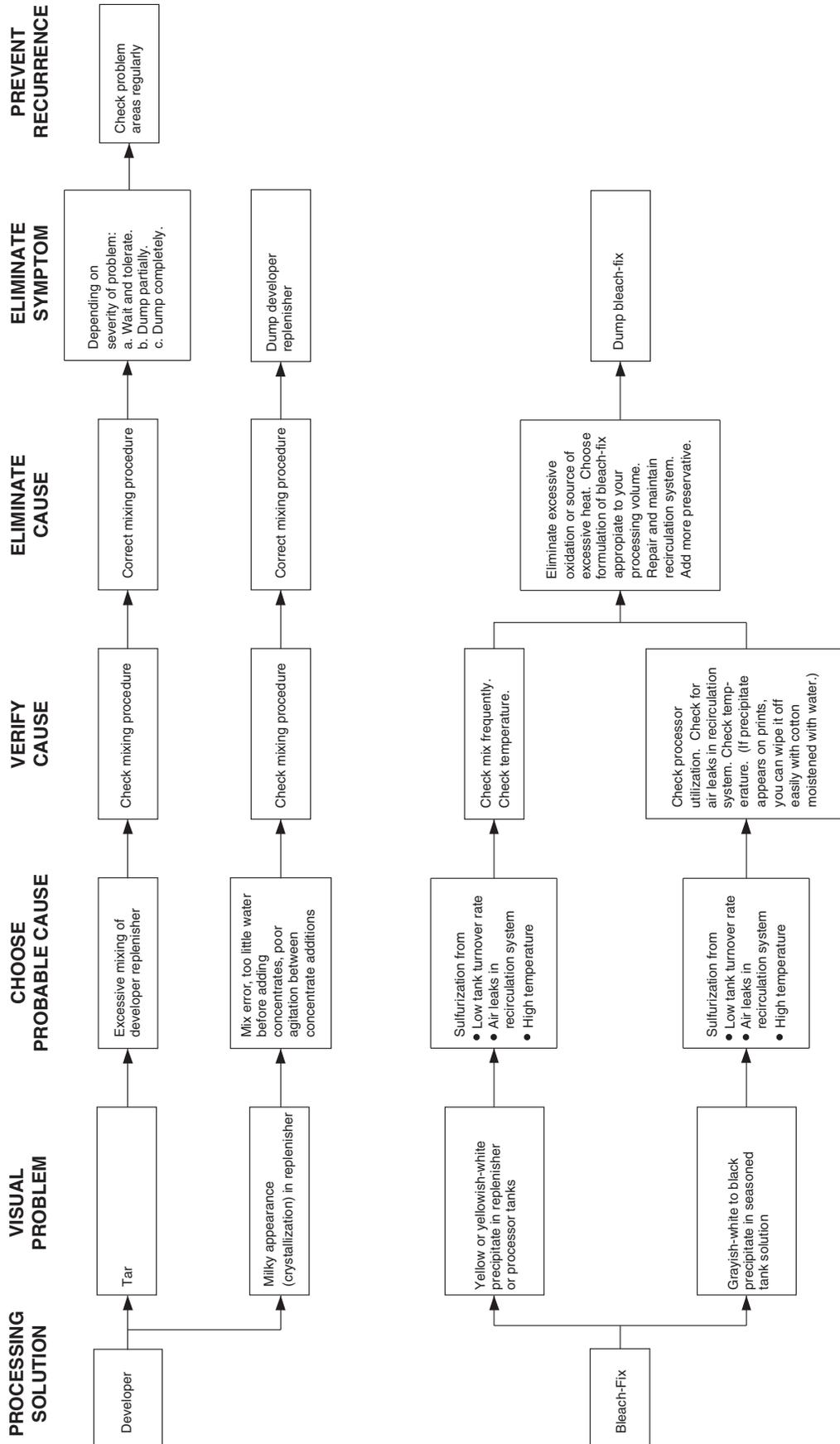
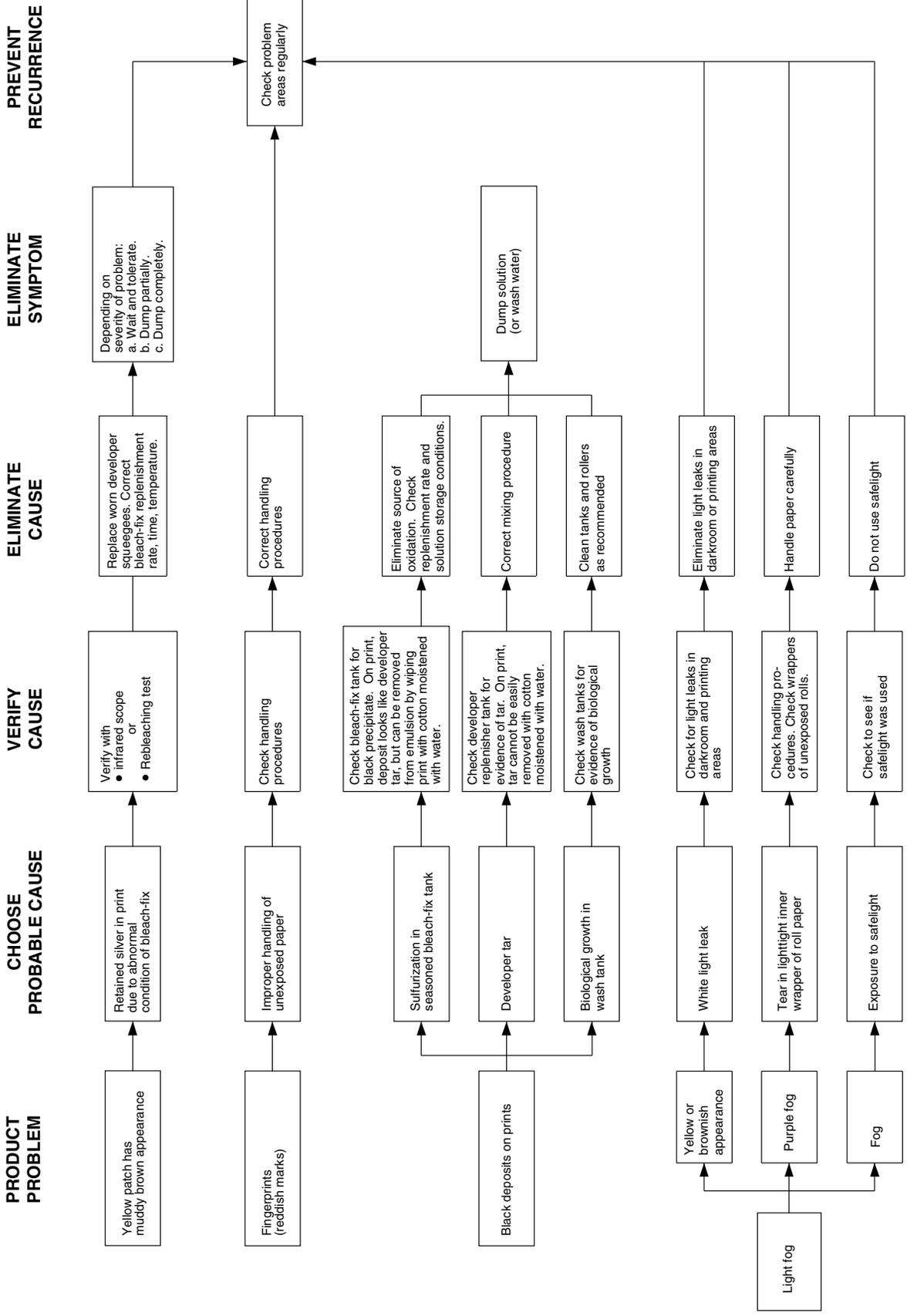
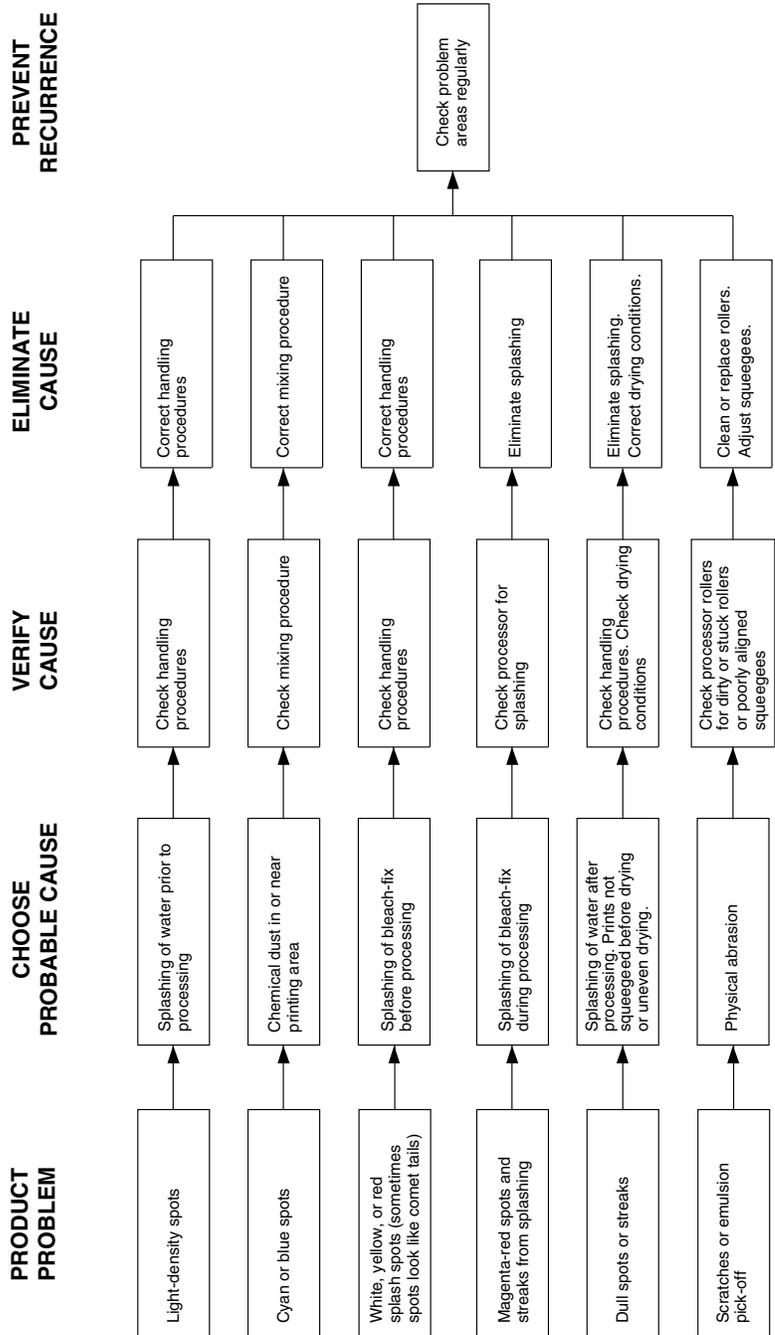


Chart G
Control-Chart Plots—Visual Appearance of Paper



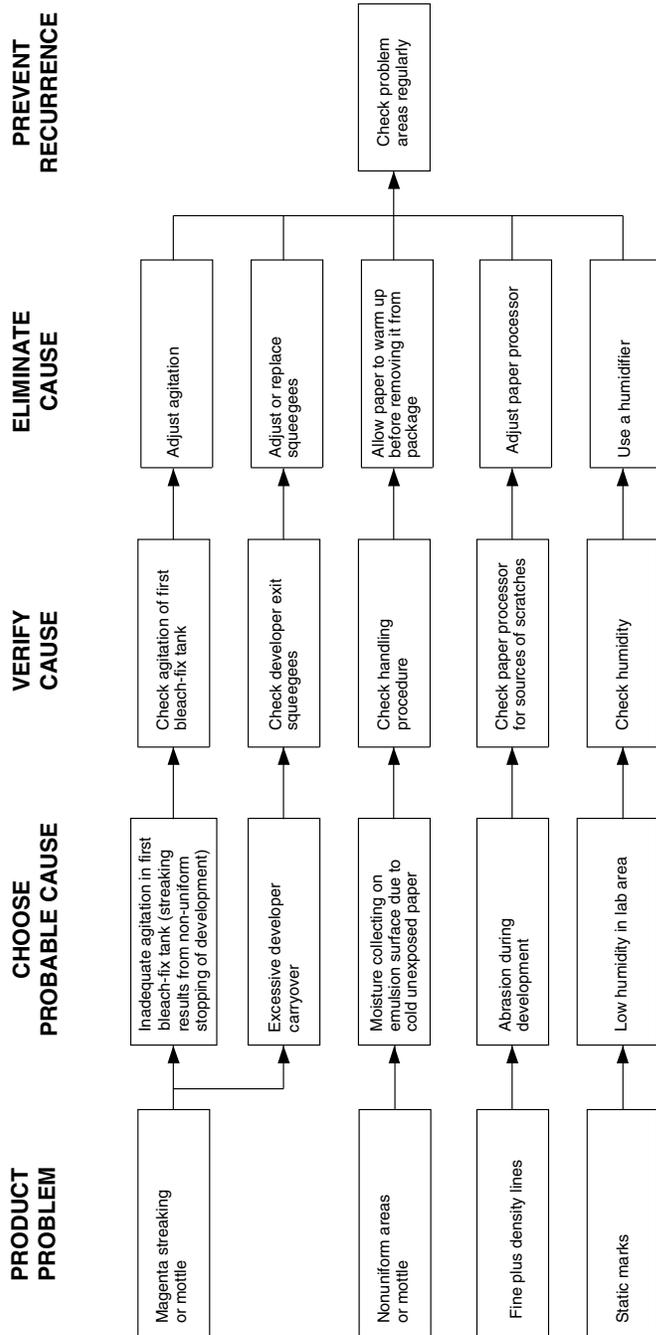
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Chart H
Control-Chart Plots—Visual Appearance of Paper



F002_9080EC

Chart I
Control-Chart Plots—Visual Appearance of Paper



F002_9081EC

CONTROL-CHART EXAMPLES

Generally, the control-plot patterns you can detect when you use KODAK Control Strips, Process RA-4, result from processing problems that can be summarized in the following three charts. The charts are intended *only as guides*; your plots may not look exactly like these examples.

The exact appearance of the control plot depends on the specific mechanical design of the processor and the condition of the chemical concentrations in the processor tank. You may also have more than one problem affecting your process. Beside each chart is a description of potential causes and remedies for problems.

Use these charts with the *DIAGNOSTIC CHARTS* and the descriptions under *INTERPRETING YOUR CONTROL PLOT* to analyze process problems.

Chart	Solution	Condition
1	Developer	Developer Activity
2	Developer	Contamination with Bleach-Fix

Although we have not included a control plot pattern for the effects of developer oxidation, a discussion of the results you can expect and the possible remedies follows the control chart examples.

Developer Activity

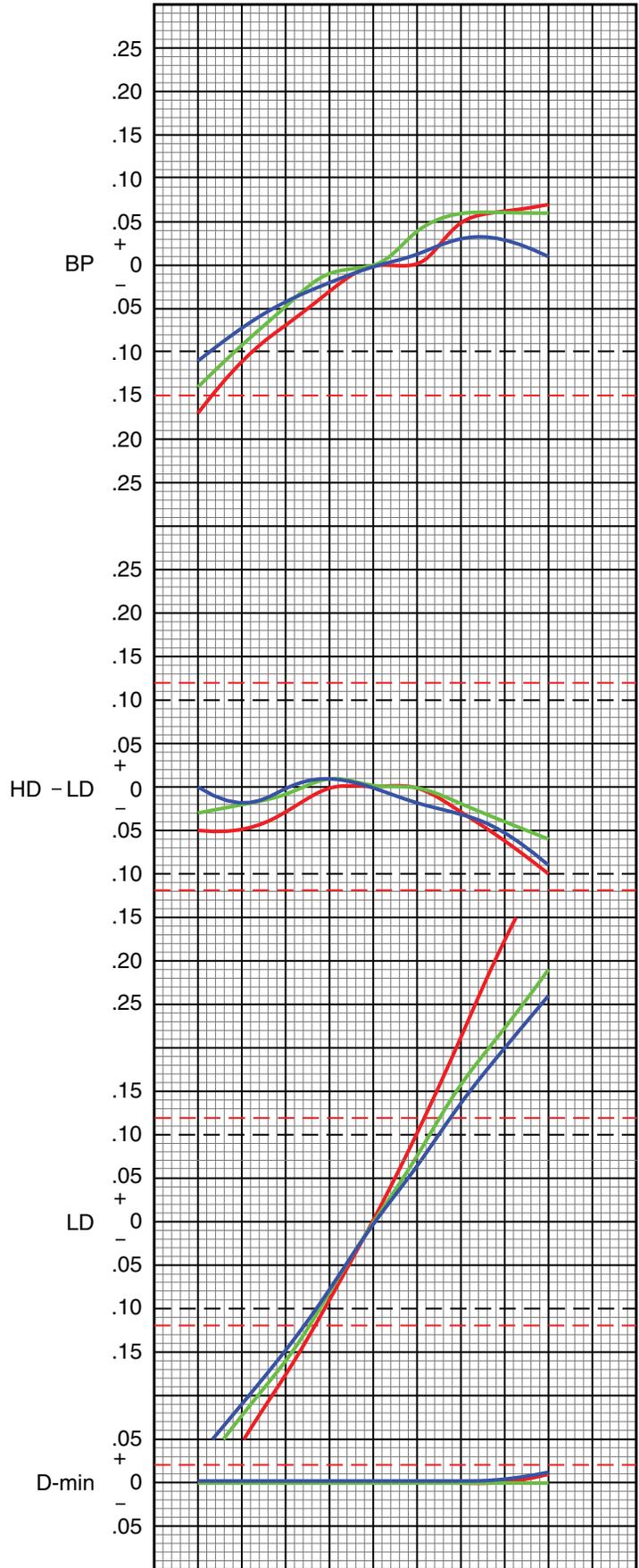
Developer—High or Low Activity

When the developer activity is too high relative to the process aim, the density of the processed materials will be too high, and the prints will be dark. If the developer activity is too low, the prints will be too light.

High and low developer activity have several potential causes. They all produce control-plot patterns very similar to that shown in Chart 1. The process problems that would cause the large shifts shown in Chart 1 would result from gross errors in operation. For example, a low-temperature shift of -11°F or a high-temperature shift of $+11^{\circ}\text{F}$ would cause shifts of the magnitude plotted here.

If your problem is caused by high or low developer activity, you should consider each of the potential causes. Also, be aware that the condition may have more than one cause, or one problem may be partially compensating for another. When you detect a developer-activity problem, it is good practice to verify all the operational conditions for the processor.

Chart 1



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Developer—Time Too Short or Too Long

The recommended developer time for Processes RA-4 is 45 seconds*. If the developer time is too short or too long, it will affect development and the amount of dye formed.

Developer times that are too long will produce higher-than-normal LD, HD – LD, and BP density values.

Developer times that are too short will produce lower-than-normal LD, HD – LD, and BP density values.

Developer-time variations can occur in processors because of variations in electrical load and differences in motor temperature from a cold start to equilibrium. Electrical-load variations can be caused by other equipment (e.g., a heater) on the same power line. In some cases, you may need a voltage regulator on the processor drive motor to compensate for external voltage variations.

Mechanical problems, such as misaligned moving parts, can cause developer-time problems. Be sure that the transport is functioning properly. Extended developer times can also result from intermittent paper slippage in the developer tank. Use a stopwatch to measure the developer time, and compare it with the machine setting.

Developer—Temperature Too Low or Too High

The recommended developer temperature for Process RA-4 is $35 \pm 0.3^\circ\text{C}$ ($95.0 \pm 0.5^\circ\text{F}$) for KODAK EKTACOLOR RA Developer Replenisher or KODAK EKTACOLOR RA Developer Replenisher RT. For EKTACOLOR Developer Replenisher 12 (EKTACOLOR Developer Replenisher 161 in Europe) and EKTACOLOR PRIME Developer Replenishers, the recommended temperature is $37.8 \pm 0.3^\circ\text{C}$ ($100.0 \pm 0.5^\circ\text{F}$)*.

A developer temperature that is too low or too high affects development and the amount of dye formed. If the developer temperature is too high, the density values for LD, HD – LD, BP, and perhaps D-min will plot higher than normal. If the developer temperature is too low, the density values for LD, HD – LD, and BP will plot lower than normal.

If you suspect that the developer temperature is incorrect:

- Check that the temperature regulator is operating.
- Check that the developer had enough time to reach operating temperature before processing.
- Check that the temperature of the replenisher solution was not too low or too high.
- If your processor has more than one developer tank, check that the temperature is the same in all tanks. Check that the temperature within each tank is uniform from top to bottom and side to side.
- Check that the developer recirculation filter is not clogged. A clogged filter can prevent proper heating of the solution. Check for constricted circulation lines.

The temperature controller and the recirculation system—individually or in combination—can cause temperature problems. Replace the recirculation filters if they are clogged.

If the temperature of the developer replenisher is too low or too high, it may be affecting the temperature of the tank solution. If this occurs, you may need to provide more heat in the replenisher storage area or heat the replenisher before using it.

Check the developer temperature frequently, and adjust it as necessary. Also, check the developer temperature periodically while the processor is operating under full load. The heater may not be able to maintain the temperature as fresh replenisher and a maximum load of paper are entering the developer.

* Time and temperature specifications for other processes and processors can be found in Current Information Summary publications and Processing (Z) Manuals at www.kodak.com/go/photochemicals.

Developer—

Replenishment Rate Too Low or Too High

Developer activity varies directly with the replenishment rate. If the rate is too low, the LD, BP, and HD – LD density values will plot lower than normal. If the rate is too high, the density values for LD and BP will plot higher than normal. The amount of change that you see in control-strip plots due to incorrect replenishment depends on the developer-tank volume, processor speed, and the amount of paper processed.

The recommended replenishment rates are *starting points only*. The exact rate depends on the type of processor and replenisher mixing and storage conditions. It can also depend on how well you maintain operating conditions, such as development time and temperature. Determine your exact rate by monitoring the process with control strips and adjusting the rate as needed according to the control plots. **Do not** adjust the rate to “chase” small changes in the control plots. Once the process is in control, continue to use the rate you established; don’t change it unless processor utilization changes. Be aware that the rate of change after a replenishment-rate adjustment may be relatively slow; you may not see the full impact of a developer replenishment-rate change for several weeks.

To avoid replenishment problems, check the replenisher settings regularly to be sure that the correct rates and tank volumes are maintained.

If you suspect that replenishment is the problem:

- Check that the replenishment system is set correctly.
- Check that your calculations are correct if you set your replenishment rate for the average paper width being processed. Does the paper width vary seasonally? Check your replenishment rate by using this calculation.

$$\begin{array}{ccccccc} \text{Flow} & & \text{Processor} & & \text{Paper} & & \text{Replenishment} \\ \text{Rate} & = & \text{Speed} & \times & \text{Width} & \times & \text{Rate} \\ (\text{mL/min}) & & (\text{m/min or ft/min}) & & (\text{m or ft}) & & (\text{mL/m}^2 \text{ or ft}^2) \end{array}$$

- Check that the processor was receiving replenishment when you detected the problem.
- Check for a possible mechanical problem with the replenishment system. Is the system replenishing at a constant and repeatable rate?

If *underreplenishment* is the cause of the problem, adjust the replenishment rate to the correct rate. To correct the underreplenished processor tank condition, remove enough developer tank solution so that you can add replenisher in 5- to 10-percent increments of tank volume. Repeat if needed to correct the tank condition. After each addition, recirculate the developer for approximately 10 minutes before you process another control strip.

If *overreplenishment* is the cause of the problem, adjust the replenishment rate to the correct rate. To correct the overreplenished processor tank condition, remove enough developer tank solution so that you can add water and starter to bring the process back into control. Add one part starter to 11 parts water. If the process is not far out of control, add the water and starter in 5-percent increments of tank volume. If the process is grossly out of control, add water and starter in 10-percent increments. After each addition, recirculate the developer for approximately 10 minutes before you process another control strip. If the process is still out of control after you have added water and starter equivalent to 20 percent of the tank volume, replace the tank solution with a fresh mix.

Developer—Fresh-Tank Mixing Error—Too Little or Much Starter

Using *too little* starter in a fresh developer mix will increase developer activity. You will see this in the control plots as an increase in the LD and HD – LD density values.

Using *too much* starter for a fresh developer tank solution decreases developer activity. You will see this in the control plots as a decrease in the LD, HD – LD, and BP density values.

To avoid these fresh-tank mixing errors, carefully follow the directions provided with the developer.

If you know the amount of starter that was left out, you can add the missing amount. If you added too much starter or do not know the amount of the error, it will be difficult to correct the problem without a chemical analysis. Replace the tank solution with a fresh mix.

Developer—Mixing Error—Incorrect Water/ Replenisher Ratio

Developer activity is affected by a mix that is prepared with too little replenisher and topped with water, or with too little water and topped with replenisher.

Using too much water and too little replenisher has the greater effect. You will see this as lower-than-normal LD, HD – LD, and BP values in the control plots.

If you use too much replenisher and too little water, the effect in the control charts will be slight.

Review your mixing procedures and verify the mix-tank calibration. Follow the mixing order in the instructions provided with the chemicals.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Replenisher Mixing Error—Too Little or Too Much Part A

Using the wrong amount of any of the developer components affects developer activity. Too little Part A causes high activity; too much Part A causes low activity.

Omitting Part A entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for possible sources of error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer Replenisher Mixing Error—Too Little or Too Much Part B

Using the wrong amount of any of the developer components affects developer activity.

Omitting Part B entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for sources of possible error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Replenisher Mixing Error—Too Little or Too Much Part C

Using the wrong amount of any of the developer components affects developer activity. Too little Part C causes low activity; too much Part C causes high activity.

Omitting Part C entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for sources of possible error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Contamination With Bleach-Fix

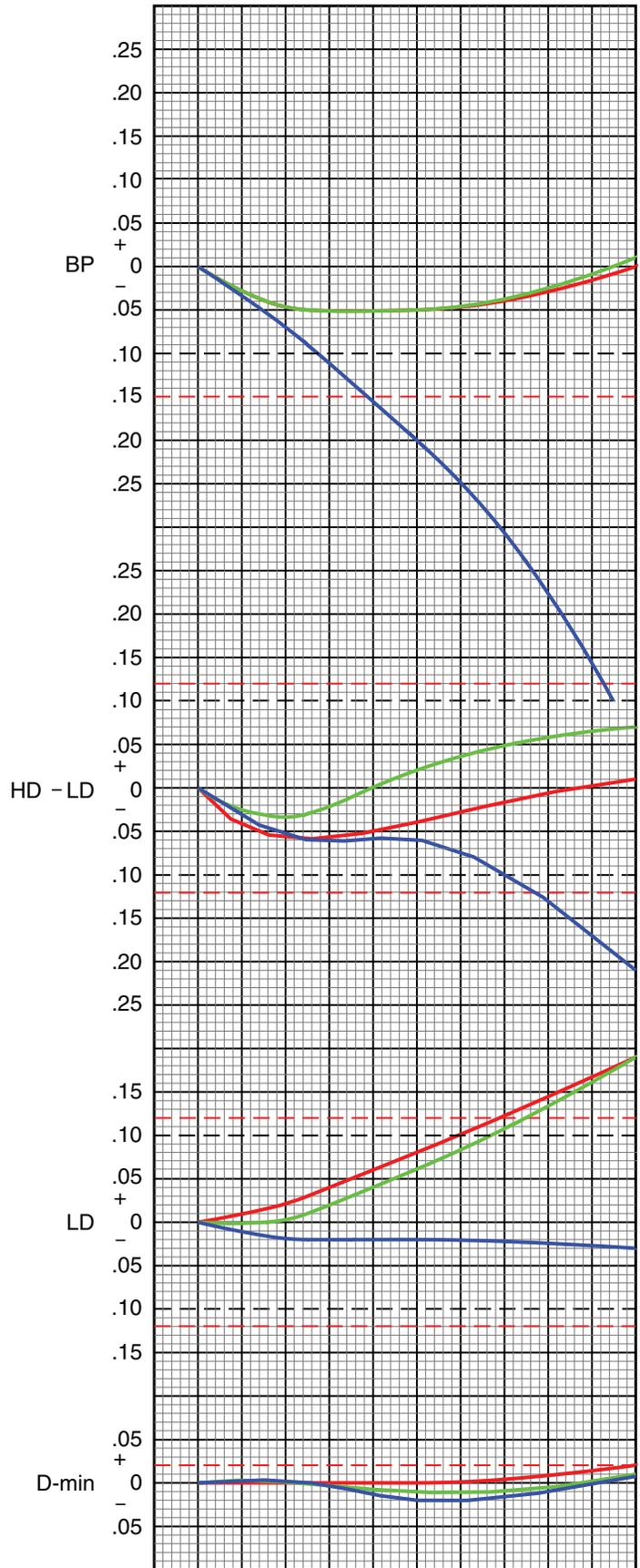
Chart 2 demonstrates that very small amounts of thiosulfate (also called hypo) from the bleach-fix will contaminate the developer. As little as 0.1 mL of bleach-fix per litre of developer can put a process out of control. If the developer is contaminated with bleach-fix, you will see a severe color change in the prints and large shifts in the control plots. You will also see an increase in D-min.

The chart shows the typical plot pattern that results from bleach-fix contamination of a developer tank. The degree of contamination is severe in this example; the most severe contamination shown is at 2.4 mL of EKTACOLOR RA Bleach-Fix NR Replenisher per litre of developer.

Possible causes of bleach-fix contamination are bleach-fix splashed into the developer when the racks are raised or mixing developer with equipment that contains a small amount of bleach-fix. Check for any procedures that might cause splashing during mixing or processing. If possible, use separate mixing tanks for developers, and wash all mixing equipment thoroughly before reusing it.

Stop production until you find the source of the contamination. A developer contaminated with bleach-fix or fixer cannot be salvaged; replace it with a fresh mix.

Chart 2



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Developer—Oxidation

When developer is exposed to air, it reacts with oxygen. To protect the developing agent, developers contain preservatives that react with oxygen. However, prolonged exposure to air will eventually deplete the preservatives and cause the developing agent to oxidize. Oxidation of the developing agent causes decreased developer activity and precipitate formation.

It is difficult to produce a representative plot pattern for the effects of developer oxidation, because it depends on the degree of aeration of the tank. Also, if you adjust your developer replenishment rate in an attempt to reduce the process control bias, you may be masking the impact of the oxidation. Generally, you will see an increase in BP, HD – LD, and D-min in the control plots.

The most common causes of oxidation are excessive agitation and low processor utilization. Excessive agitation—e.g., from long or too rapid mixing or too much agitation in the processor—forces air into the solution. A faulty processor recirculation pump can also suck air into the solution. Foaming may indicate that the recirculation system is leaky and is sucking air.

Oxidation is a more common problem in roller-transport processors than in other type of processors, because the rollers constantly expose large areas of solution to the air. Oxidation is also more likely in roller-transport processors because they often have low utilization, which means that the solution is exposed to air for long periods without replenishment. Without replenishment, preservatives in the developer are not replaced as they would be with normal utilization. Evaporation is also higher in low-utilization processors, and leads to overconcentration of the developer. Overconcentration may offset some of the effects of the oxidation and mask the condition.

Minimize oxidation by turning off the processor when it is not in use. In roller-transport processors, use solutions that contain extra protection against oxidation, such as KODAK EKTACOLOR RA Developer Replenisher RT.

Check for excessive air flow over the processor developer tanks and developer replenisher storage tanks. Use floating lids on storage tanks. Avoid overmixing and excessive agitation.

7 Process Monitoring and Troubleshooting with KODAK PROFESSIONAL Pro Strips Color Negative Paper Control Strips / for Process RA-4

To produce high-quality color prints consistently and with a minimum of waste, you need to match your process to a standard for density, color, and contrast each time you process paper or print and display materials. In addition to monitoring process parameters such as solution times, temperature, replenishment rates, solution concentrations, etc., you should regularly run control strips to ensure best results.

Kodak provides KODAK PROFESSIONAL Pro Strips, CAT 129 8587, for monitoring Process RA-4 in professional labs. These strips are designed specifically for use with KODAK PROFESSIONAL Media. The recommendations for using these strips are essentially the same as those for KODAK Control Strips, Process RA-4.

KODAK PROFESSIONAL Pro Strips, Process RA-4, are designed to detect process conditions that can degrade the quality of your finished prints and materials. They are better able to track the papers and materials that are processed in professional finishing laboratories. When you begin using the PROFESSIONAL Pro Strips, you may find that your process is “out of control”—often in the Blue BP or Blue HD - LD control values. This indicates that you can improve the process to take full advantage of the quality of KODAK PROFESSIONAL Papers and Materials.

This section describes standards and methods for setting up your process and for ongoing process monitoring. The primary “tools” for monitoring your process are the control strips and the reference strip. This section also describes how to use PROFESSIONAL Pro Strips and interpret the results. For the most up-to-date information, you can check the Kodak website, www.kodak.com/go/photochemicals.

PROCESS-MONITORING TERMS

The following terms are commonly used in process monitoring:

Action Limits—The action limits are the boundaries of the aim operating range of the process. As long as the control-strip 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 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—You compare your control-strip density readings to these values. To obtain aim values, read the reference-strip densities; then apply the correction factors (supplied with the control strips and reference strip) to those density readings. Enter the aim values in the spaces provided on the left side of your control chart.

Control Limits—The control limits define the maximum tolerances that are acceptable for processing customer work. If any density value of your process plots beyond the control limit, the process is out of control. Results will be unsatisfactory for color, density, and/or contrast. When any density value plots beyond the control limits, stop processing customer work until you find the cause of the shift and correct it.

Control Strips—These are precisely exposed strips 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 batch (code number) of control strips.

Reference Strip—This is a control strip that has been precisely exposed and processed by Kodak under 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. The tolerances and limits for KODAK PROFESSIONAL Pro Strips, Process RA-4, are listed in Table 7-1.

**Table 7-1
Tolerances and Limits for KODAK
PROFESSIONAL Pro Strips, Process RA-4**

Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits
D-min	—	—	+ 0.02
LD	± 0.04	± 0.07	± 0.10
HD – LD	± 0.03	± 0.07	± 0.10
BP	± 0.05	– 0.10	– 0.15

KODAK PROFESSIONAL PRO STRIPS PROCESS RA-4

The Basic Control Material

These strips are available in boxes of ten moisture-resistant 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 particular batch and has the format Y9XX, where Y indicates the year, 9 identifies the code as KODAK PROFESSIONAL Pro Strips, and XX is a sequential number. Each box contains correction factors for that particular code number. Use these correction factors to calculate the aim values for each batch of strips.

Each strip measures $3\frac{1}{2}$ 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. Low bleach-fix

activity will make the yellow patch appear brown and less saturated than normal.

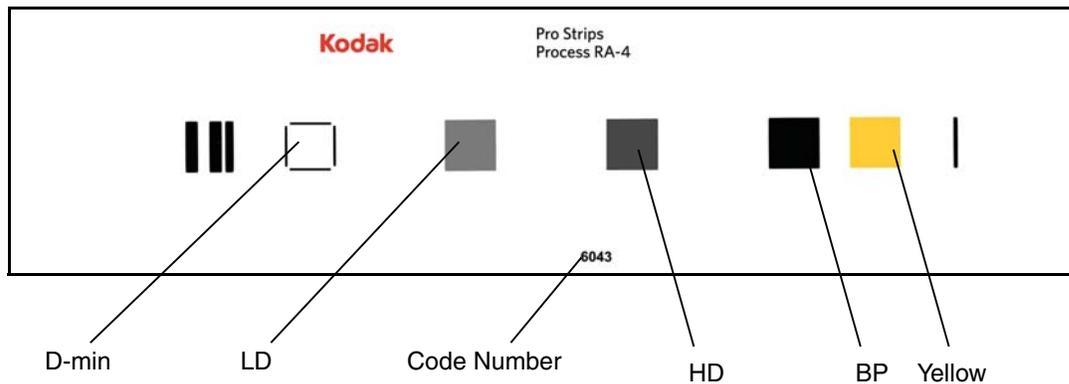
Storing and Handling Control Strips

Store unused control strips 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; then reseal and return the package to the freezer as quickly as possible. **Do not** keep the package out of the freezer for more than one hour per day.

Store your daily supply of control strips in a lighttight container at room temperature. Be sure to allow the strips to reach room temperature before you process them. Handle control strips by the edges to prevent fingerprints and surface damage.

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

Figure 7-1



Starting Out

To begin process monitoring, you will need—

- KODAK PROFESSIONAL Pro Strips, Process RA-4
- An electronic densitometer equipped with Status A filters
- KODAK Process Record Form, KODAK Publication No. Y-55, or similar graph paper. (A blank Y-55 is available at www.kodak.com/go/retailerresources.)
- Red, green, and blue pencils

You can also use the KODALINK Service Software to easily read, plot, and store your results. One of the many advantages of this system is that all calculations around setting the aim and plotting the measurement results are done by the system, including automatic application of control strip correction factors. For more information about this system, contact your Kodak representative or distributor.

Processing Control Strips

Each time you process a control strip, position it in the same location in your processor. Follow this schedule for processing a control strip:

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

Plotting Control-Strip Densities

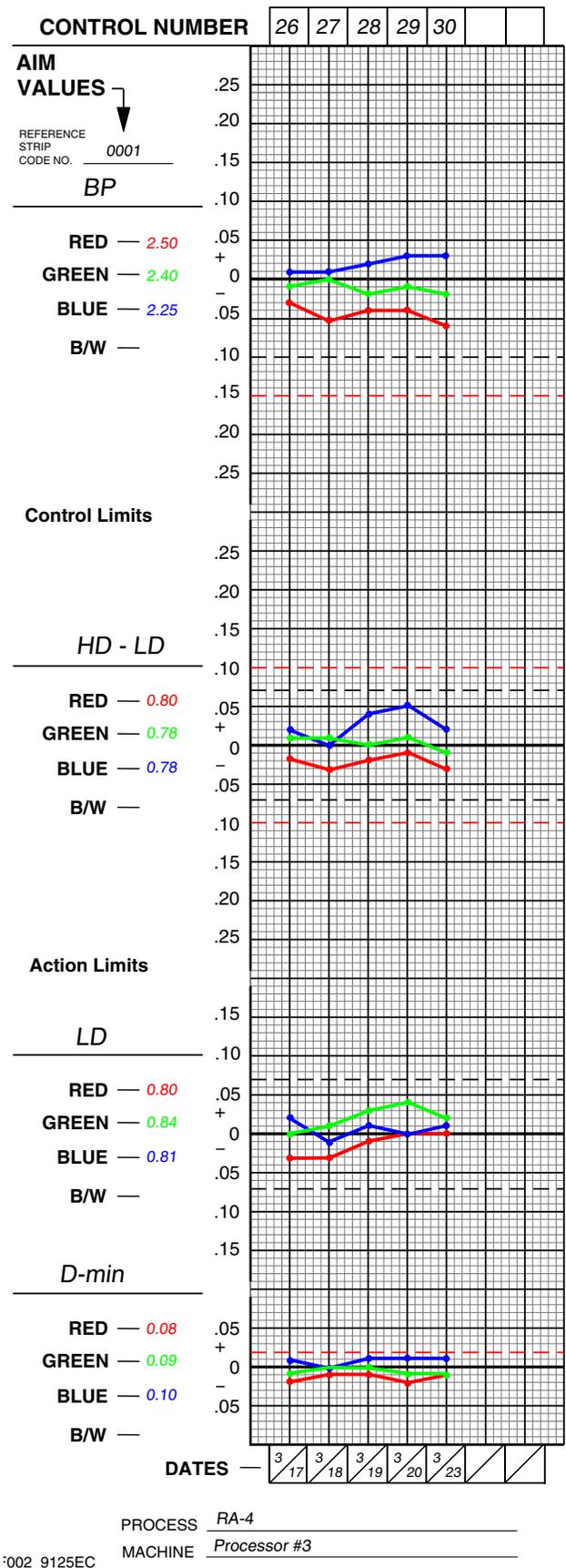
Create a control chart by using the KODAK Process Record Form Y-55 or similar graph paper (see the example in Figure 7-2). Then follow the procedure below:

1. Draw in the action and control limits given in Table 7-1. Use black for the action limits and red for the control limits.
2. Remove the reference strip from the box of control strips.

IMPORTANT: 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 to return the readings to normal values.

3. Use a precision electronic densitometer to measure the Status A red, green, and blue densities in the center of the D-min, LD, HD, and BP patches of 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. 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, the reference strip, and the control strips identifies each batch.

Figure 7-2



4. To calculate aim values, apply the correction factors supplied in the instruction sheet packaged with the 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.

5. Process a control strip and measure the same patches that you measured in step 3.
6. Calculate the variations from aim by subtracting the aim densities from your control-strip densities. Plot the variations on your control chart.
 - Plot differences that are **larger** than the corresponding aim values (+ values) **above** the aim line.
 - Plot differences that are **smaller** than the aim values (– values) **below** the aim line.
7. If any of the variations from aim plot 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. The *DIAGNOSTIC CHARTS* and the *CONTROL-CHART EXAMPLES* will help you troubleshoot process problems.
8. Whenever you take corrective action, process another control strip to confirm that the process is in control before you resume normal processing.

Changing to a New Batch of Control Strips

When you change from your current batch of control strips to strips with a different code number, make a crossover to confirm that both batches (code numbers) will provide the same information. *Be sure that your process is stable and in control before you begin using a new batch of control strips.*

Note: When you begin using KODAK PROFESSIONAL Pro Strips for the first time, you should *not* cross over from the control strips you were using previously.

1. While you still have a week's supply of control strips of the current code, process one control strip from the new batch of strips with one strip from the current batch in *three separate runs*.
2. Read and record the densities of the processed strips.
3. Determine aim values for the new batch of control strips; follow steps 2 through 4 under *Plotting Control-Strip Densities*.
4. For your current batch of control strips, calculate the variations from aim by subtracting your current aim densities from the densities of the three strips. Plot the variations on your control chart.
5. For the new batch of strips, calculate the variations from aim by subtracting the new aim densities (calculated in step 3) from the densities of the three strips. Plot the variations on your control chart.
6. Calculate the differences between the variations from aim of the current strips and the new strips. Average these differences; then divide the result by 2.
7. Add or subtract the results from step 6 from the aim values for the new batch of strips determined in step 3. The amount of the adjustment should not exceed the aim-value adjustment tolerances given in Table 7-1. If the adjustment is greater than the tolerance, determine the cause. Check your calculations, densitometer, and control strips.
8. Record the new aim values and the code number of the new batch of strips on your control chart, and begin using the new batch of strips.

INTERPRETING YOUR CONTROL PLOT

Your control plot provides a running record of your process. It will show how consistent your process is, and how well it meets your aim. It provides you with helpful information for analyzing and correcting process problems. Your process will produce acceptable results if your control strips plot within the control limits.

Corrective Action

When one or more process parameters exceed the control limits, stop processing customer work until you find the cause of the problem and correct it. It is important to become familiar with control-chart patterns and cause-and-effect relationships. Control-chart patterns can generally be separated into three categories: high activity, low activity, and high D-min. Also, you can check your control chart to determine if the process drifted out of control slowly or changed suddenly.

High Activity

The process is out of control with process parameters plotting above aim. This condition can be caused by—

- Developer temperature that is too high
- Developer time that is too long
- Overreplenished developer (i.e., the solution is replenished at a rate that is too high)
- Mixing error
- Developer contamination

Low Activity

The process is out of control with process parameters plotting below aim. This condition can be caused by—

- Developer temperature that is too low
- Developer time that is too short
- Underreplenished developer (i.e., the solution is replenished at a rate that is too low)
- Mixing error
- Developer tank solution diluted with water
- Developer contamination

High D-min

This condition can be caused by—

- Developer oxidation resulting from low utilization
- Developer contamination
- Weak or oxidized, sulfurized bleach-fix
- Dirty stabilizer, or heavy dirt build up on wash racks/rollers

Trend

A trend shows an out-of-control condition that has occurred slowly over time. It indicates a problem such as—

Improper replenishment—Check that the replenishment rate is correct and that the replenishment system is operating properly. Also check for improperly mixed replenisher.

Evaporation or oxidation—Check for low utilization or air drawn into the processing solutions by a bad pump, a recirculation system leak, or a poorly placed ventilation fan.

Contamination—Check for photographically active materials that are leaching slowly into the solutions. The contaminants may come from anything that is in contact with the solutions, such as filters, plumbing, etc.

Incorrect mixing—Check for mixing errors caused by improper measurement, improper calibration of mixing tanks, etc. If you suspect that the problem was caused by incorrectly mixed replenisher solution, mix a new batch of replenisher to see if a fresh mix gradually corrects the problem.

Sudden Change

This is an out-of-control condition that occurs *suddenly*. It *usually* indicates a problem with—

Control strips—Check that you used control strips of the same code number. Remember, if you change code numbers, you need to establish new aim values for the new batch (see *Changing to a New Batch of Control Strips*). Check that the control-strip code numbers match those of the reference strip. Check that the strips were handled and stored properly.

Densitometer—If your densitometer is not working properly or is out of calibration, the density readings will be wrong. This can falsely signal a process change. Check that you used Status A filters.

Time or temperature—Check that the time and temperature are set correctly, particularly if they are easy to change accidentally.

Contamination—Bleach-fix splashed into the developer during rack cleaning or clearing a paper jam can cause sudden large spreads in your control plots.

Solution mixing—If the sudden change occurs after you have mixed a fresh tank solution, check that it was mixed correctly.

Aim values—Check that you compared the control-strip densities with the correct aim values.

Note: When you troubleshoot a problem, check the easiest and most obvious causes first; then check the more difficult and less likely causes.

How Each Processing Solution Affects Your Results

Each solution in Process RA-4 has a specific function. Operational errors involving each solution will affect process performance differently. When you understand the reaction of each solution, you can better diagnose processing problems.

Developer

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

The amount of cyan, magenta, and yellow dye formed depends on exposure and developer activity. Temperature, time, replenishment rate, replenisher concentration, 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-Fix

The 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 halide.

Bleach-fix performance depends on the concentration, the pH and the diffusion rate of the solution into the emulsion. Time, agitation, and temperature affect the diffusion rate. Incorrect bleach-fix conditions or an abnormal bleach-fix can affect the amount of dye formed.

Inadequate bleach-fixing may not convert all of the metallic silver to silver halide. A sign of retained silver is an increase in the black-patch (BP) densities of the control strip and a desaturation of the yellow patch on the control strip. Retained silver degrades image quality by desaturating the colors and is especially apparent when the yellow patch appears brown. It has a greater effect on higher-density areas, which contain more metallic silver. You can remove retained silver by reprocessing the paper or material in a good bleach-fix.

Wash

Washing removes residual chemicals from the paper. If the chemicals are not removed, they can degrade the image and cause the dye to fade. 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 can enter the emulsion to remove the chemicals, but not so warm that it damages the emulsion. For more information on washing, see Section 4, *Using KODAK EKTACOLOR Chemicals in Roller-Transport Processors*.

Stabilizer or Final Rinse

Washless (non-plumbed) minilabs use a stabilizer instead of a wash step. An optional cycle for roller-transport processors also uses a stabilizer to conserve water. The stabilizer removes residual chemicals from the paper or material.

Checking Prints for Retained Silver

Inadequate bleach-fixing can lead to retained silver in prints and materials. High levels of retained silver affect print quality and can also give false signals to sensors used in automatic print choppers.

Inadequate bleach-fixing is caused by dilute or underreplenished bleach-fix, a short bleach-fix time, a tank pH that is too high, or a low temperature (or a combination of these conditions). The most common cause is dilution of the bleach-fix due to ineffective developer squeegees and excessive developer carryover.

To check prints for retained silver, compare the processed control strip with the reference strip by using an infrared scope in a darkroom. When you view the control strip through the scope, the dye image will appear nearly invisible. If your process does not have a retained-silver problem, the reference strip and your control strip should look the same. If the process does have a retained-silver problem, the silver image in the control strip will be visible as a darker density, most evident in the black patch.

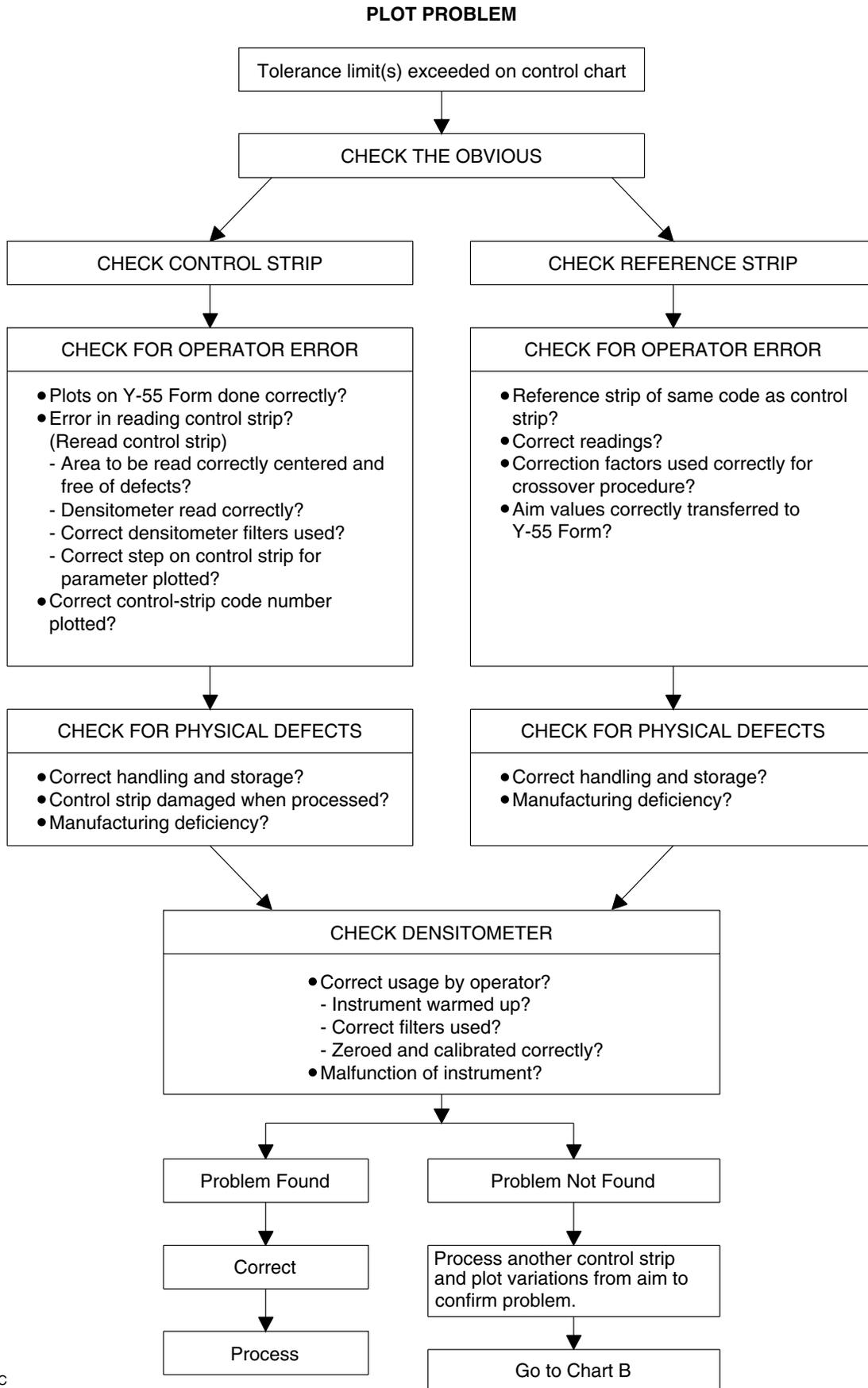
Infrared scopes are available from several sources; check the yellow pages of your telephone directory under *Scientific Apparatus and Instruments*.

DIAGNOSTIC CHARTS

The diagrams in this section provide you with a step-by-step approach to diagnosing process problems. The preliminary and summary charts show which detailed chart to check for your problem. The charts give probable causes and suggest corrective actions.

Chart	Title
A	Preliminary
B	Summary—Control-Chart Plots
C	Control-Chart Plots—High BP, HD-LD, or LD
D	Control-Chart Plots—Low BP, HD-LD, or LD
E	Control-Chart Plots—High D-min
F	Control-Chart Plots—Visual Appearance—Developer and Bleach-Fix
G	Control-Chart Plots—Visual Appearance of Paper
H	Control-Chart Plots—Visual Appearance of Paper
I	Control-Chart Plots—Visual Appearance of Paper

**Chart A
Preliminary**

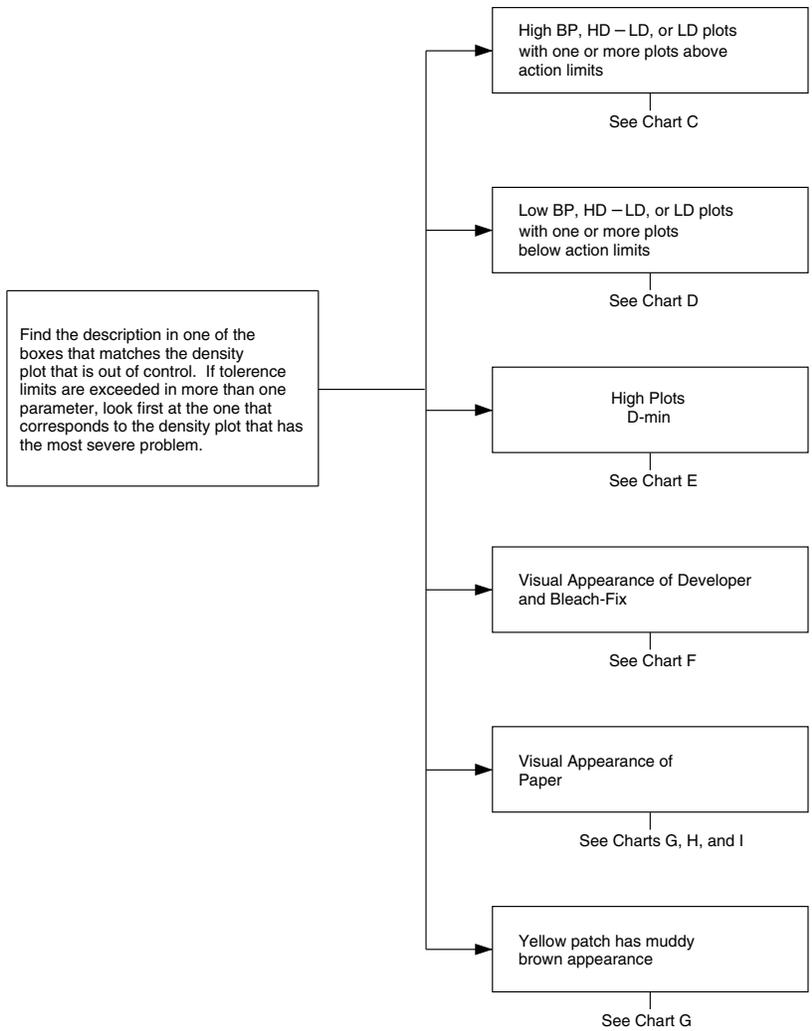


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Chart B Summary—Control-Chart Plots

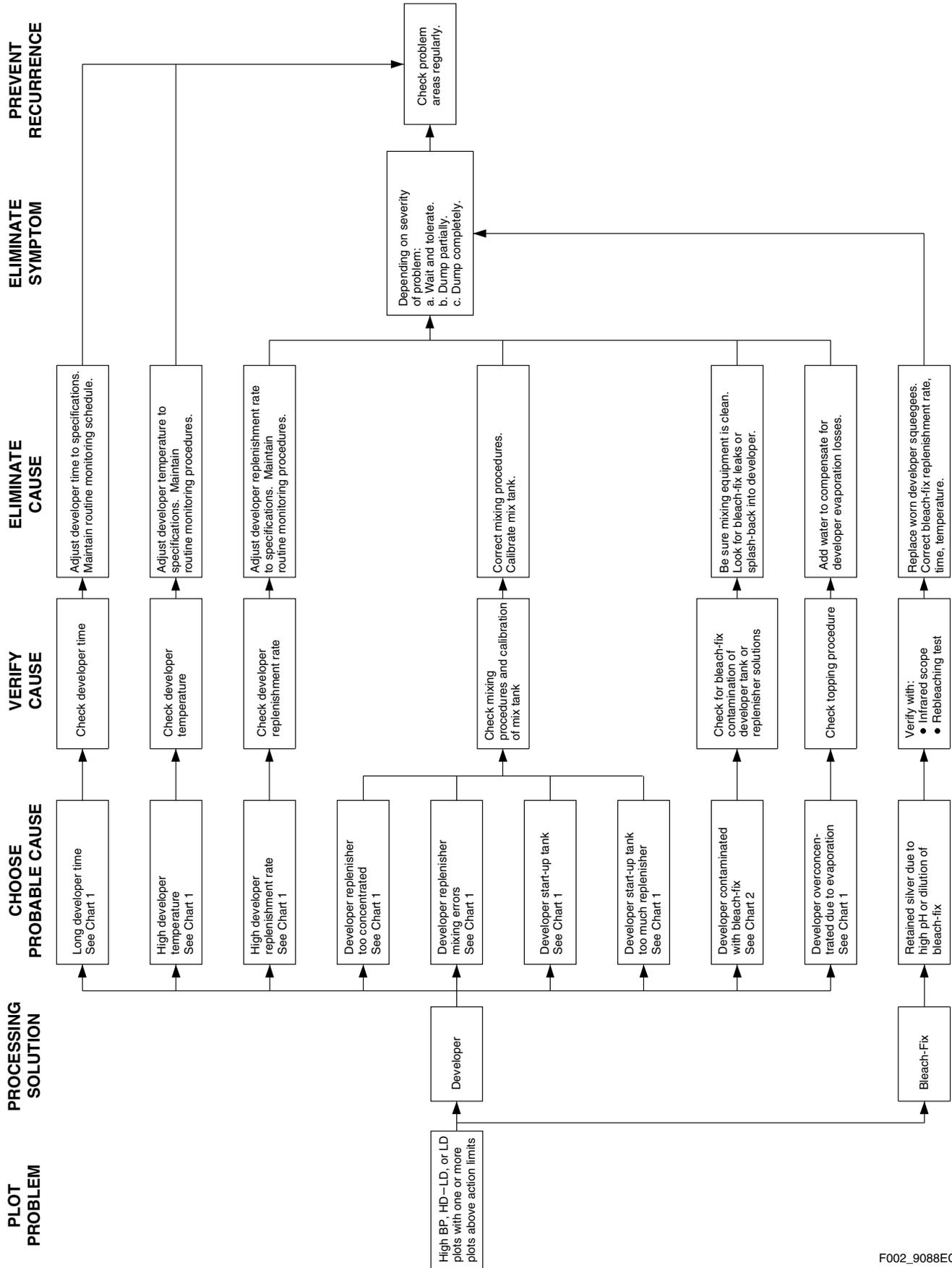
DESCRIBE PLOT PATTERN

FURTHER IDENTIFY AND GO TO SPECIFIED CHART



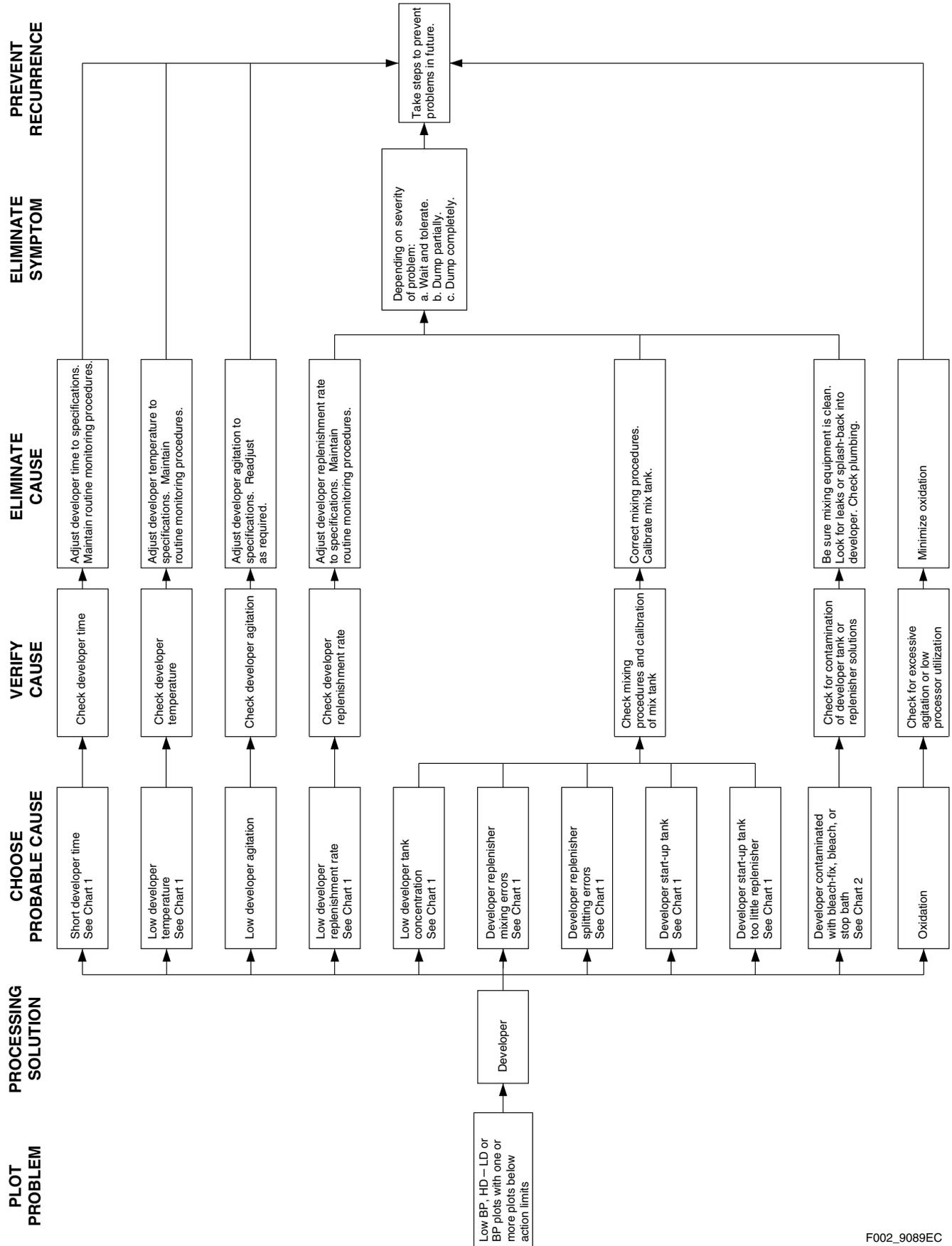
F002_9074EC

Chart C
Control-Chart Plots—High BP, HD – LD or LD



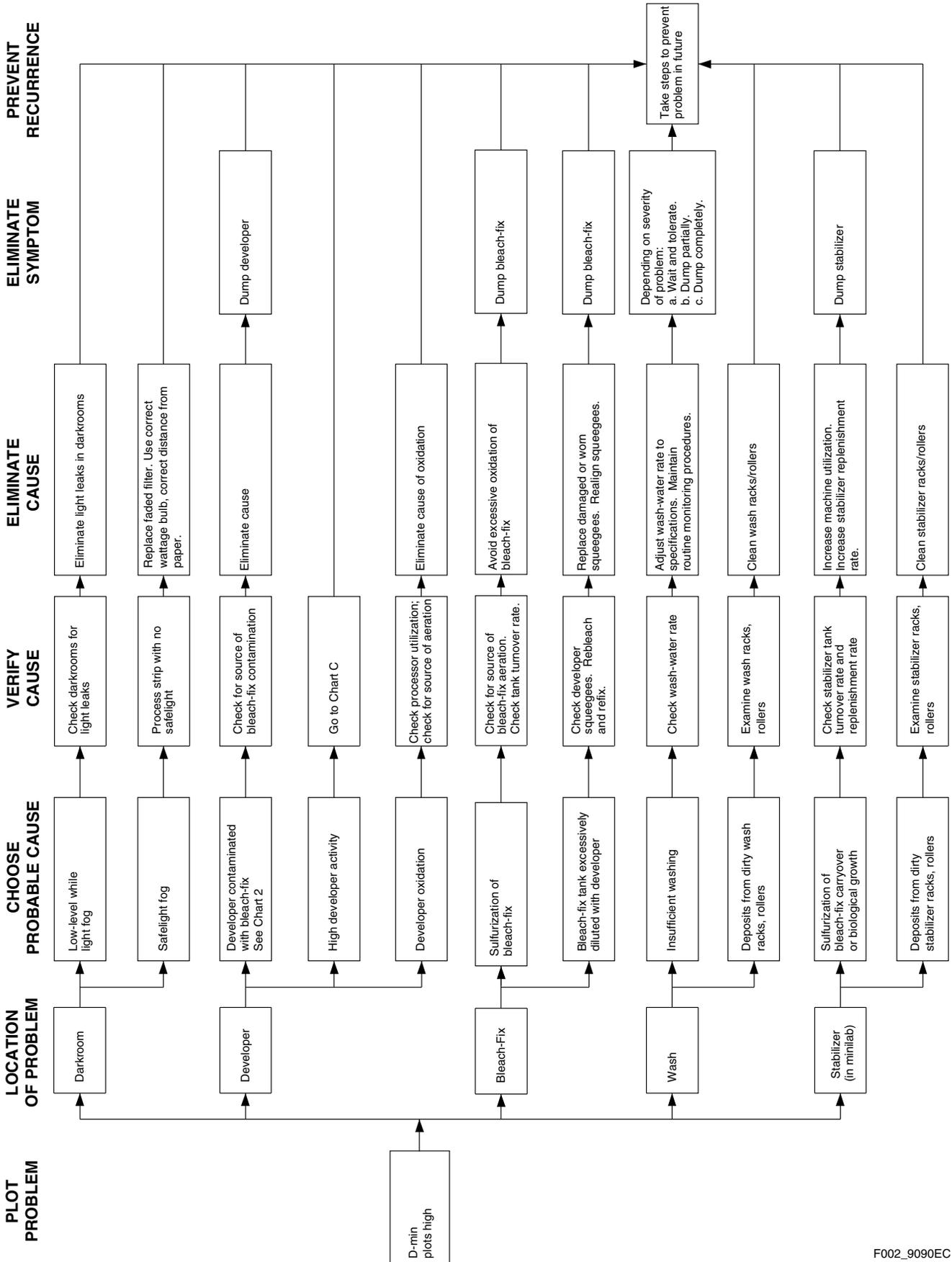
F002_9088EC

Chart D
Control-Chart Plots—Low BP, HD – LD or LD



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Chart E
Control-Chart Plots—High D-min



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Chart F
Control-Chart Plots—Visual Appearance – Developer and Bleach-Fix

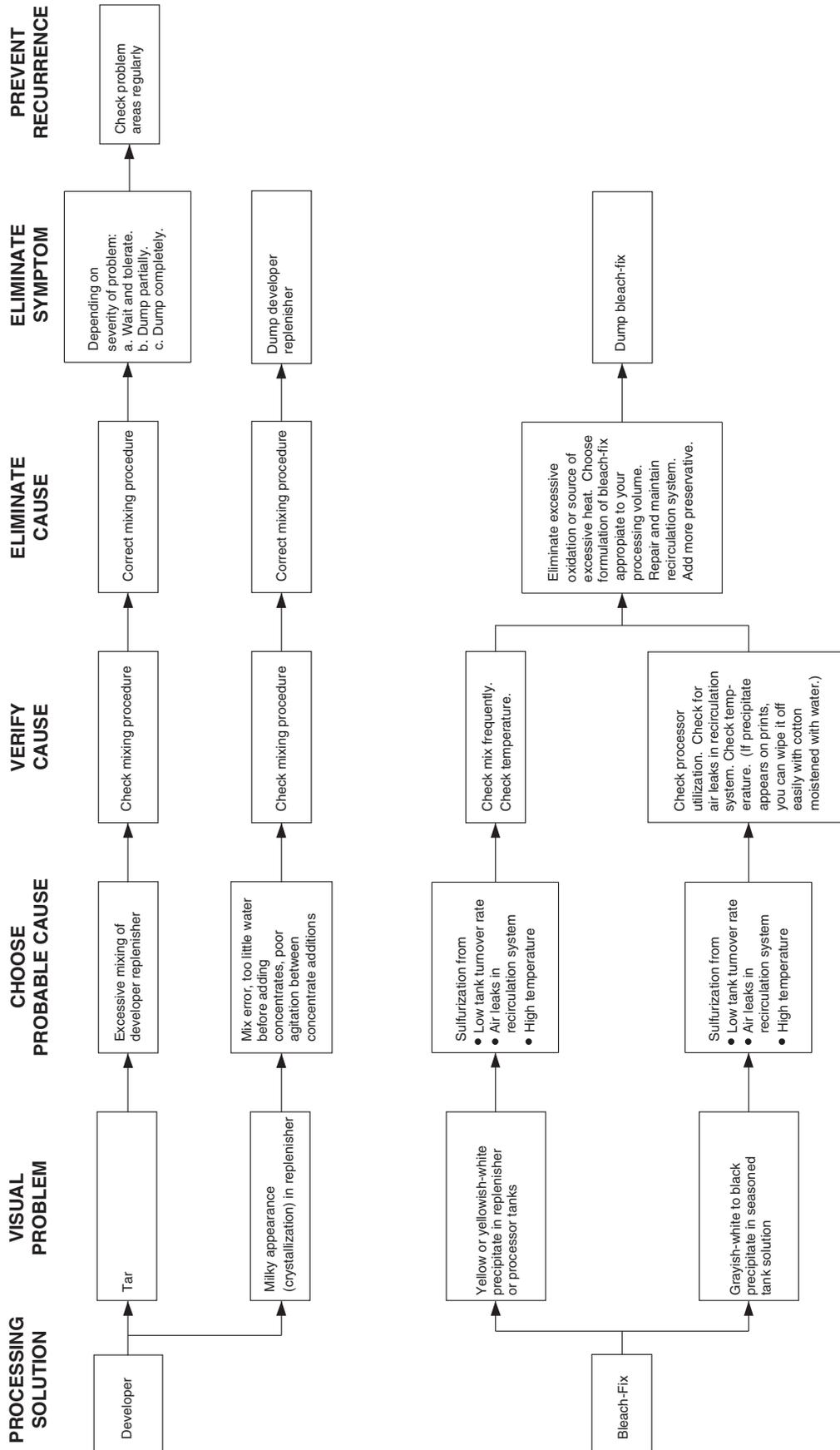
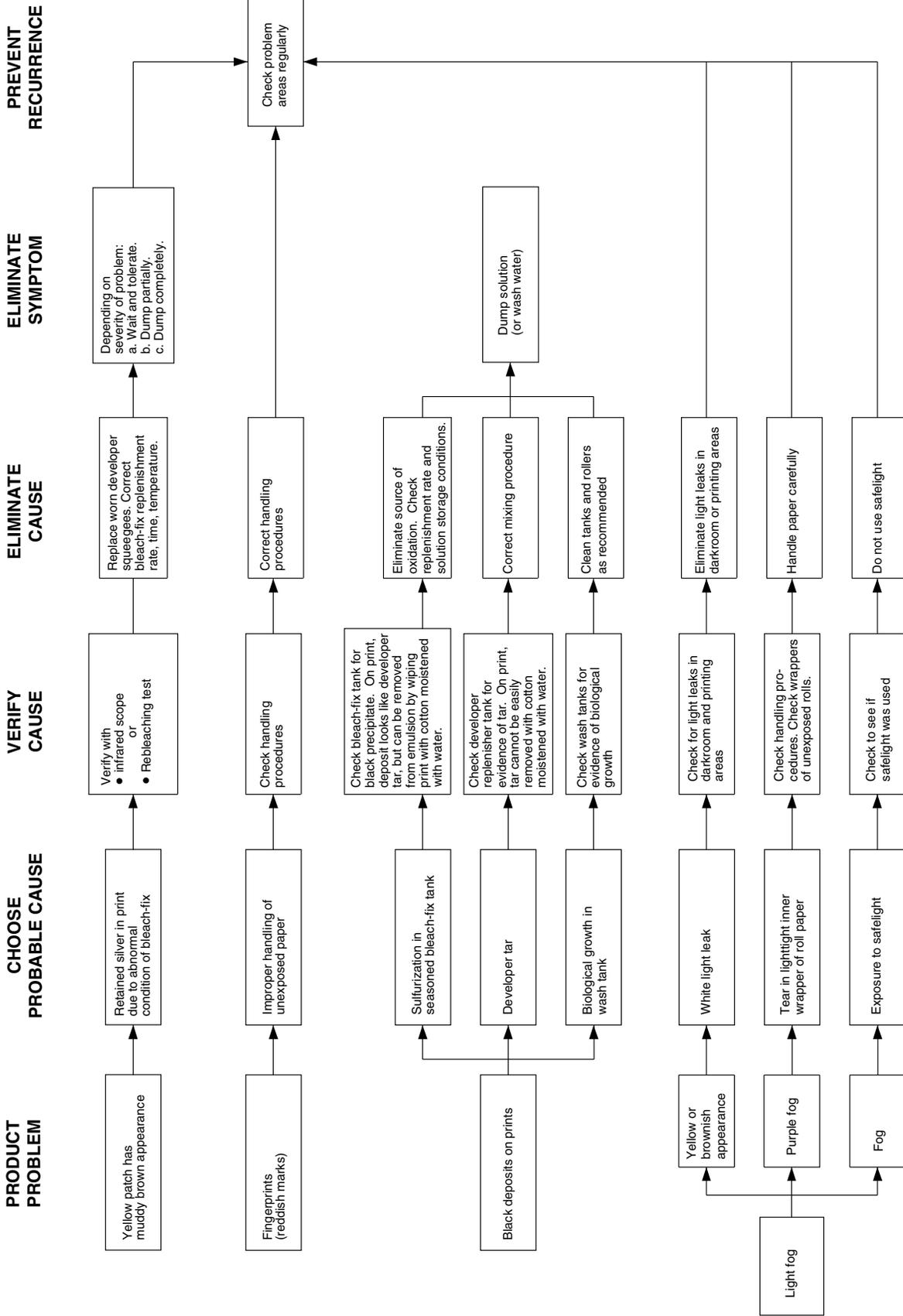
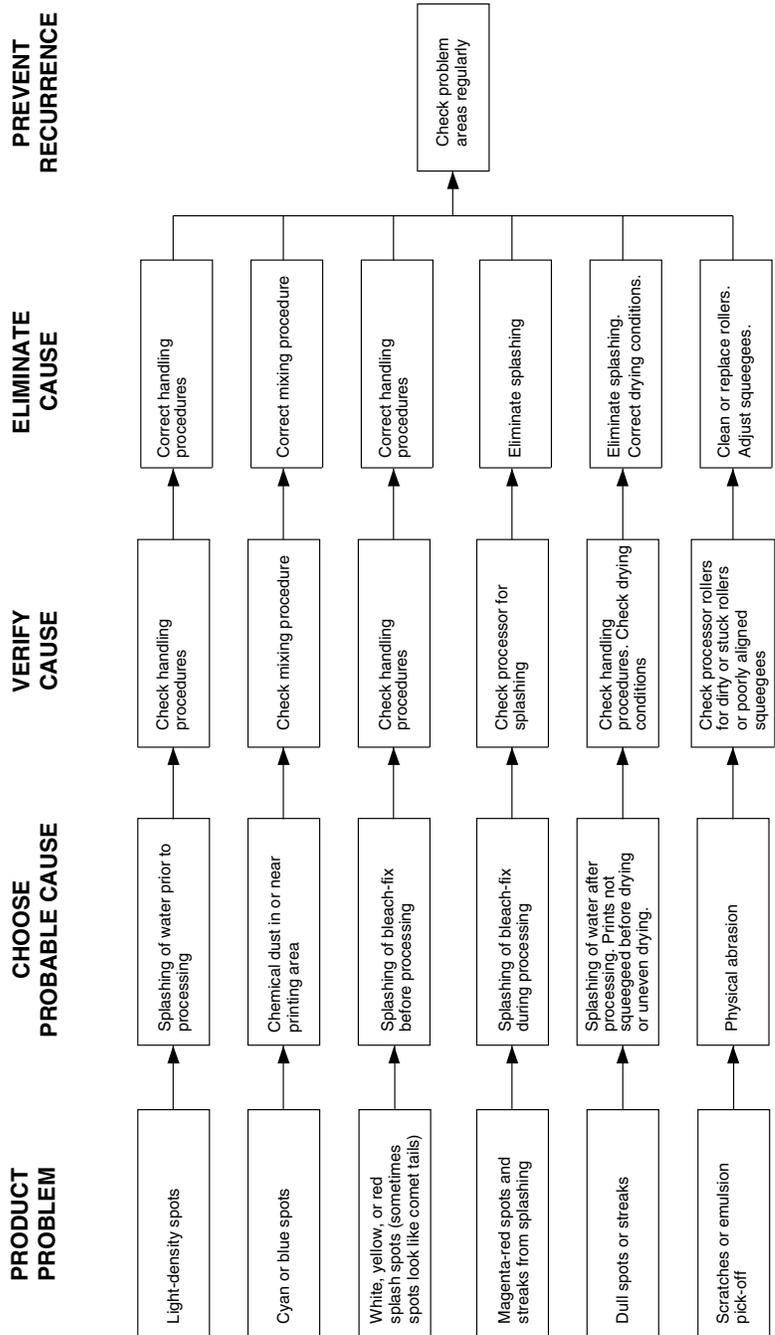


Chart G
Control-Chart Plots—Visual Appearance of Paper



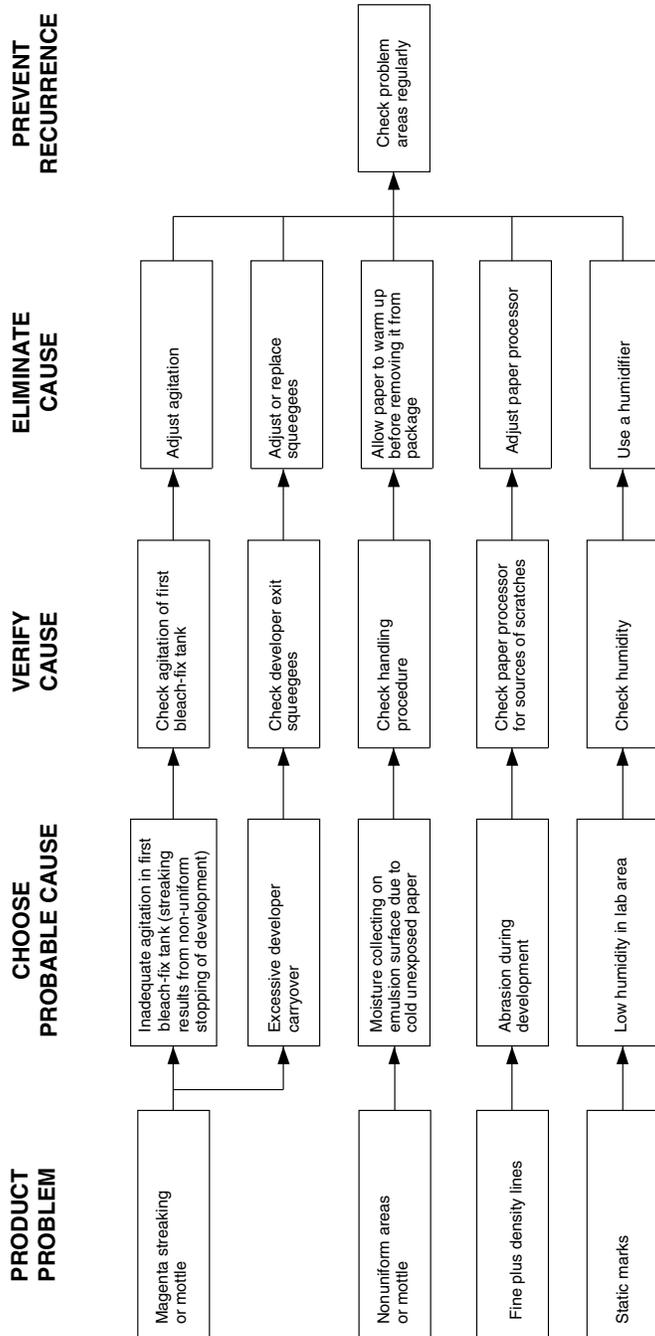
F002_9079EC

Chart H
Control-Chart Plots—Visual Appearance of Paper



F002_9080EC

Chart I
Control-Chart Plots—Visual Appearance of Paper



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CONTROL-CHART EXAMPLES

Generally, the control-plot patterns you can detect when you use KODAK PROFESSIONAL Pro Strips, Process RA-4, result from processing problems that can be summarized in the following three charts. The charts are intended only as guides; your plots may not look exactly like these examples.

The exact appearance of the control plot depends on the specific mechanical design of the processor and the condition of the chemical concentrations in the processor tank. You may also have more than one problem affecting your process. Beside each chart is a description of potential causes and remedies for problems.

Use these charts with the *DIAGNOSTIC CHARTS* and the descriptions under *INTERPRETING YOUR CONTROL PLOT* to analyze process problems.

Chart	Solution	Condition
1	Developer	Developer Activity
2	Developer	Contamination with Bleach-Fix
3	Bleach-Fix	Leuco-Cyan Dye

Although we have not included a control plot pattern for the effects of developer oxidation, a discussion of the results you can expect and the possible remedies follows the control chart examples.

Developer Activity

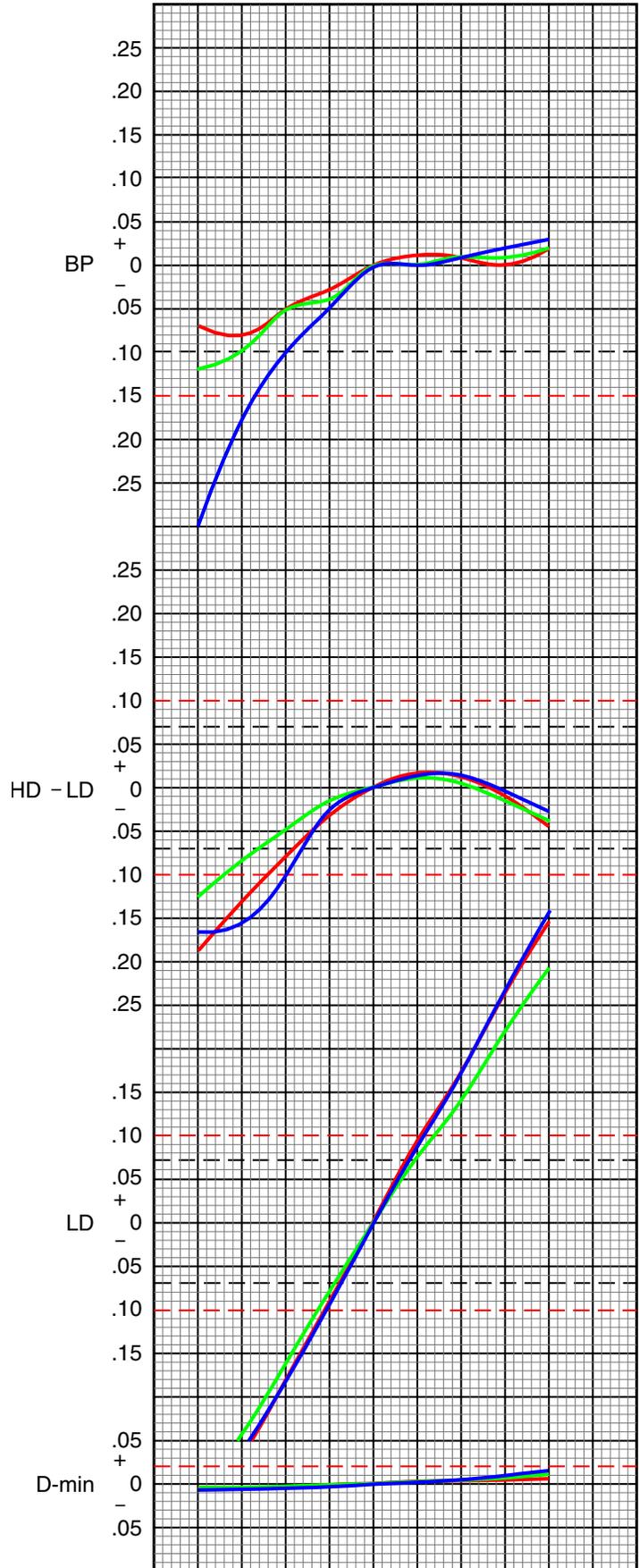
Developer—High or Low Activity

When the developer activity is too high relative to the process aim, the density of the processed materials will be too high, and the materials will be dark. If the developer activity is too low, the materials will be too light.

High and low developer activity have several potential causes. They all produce control-plot patterns very similar to that shown in Chart 1. The process problems that would cause the large shifts shown in Chart 1 would result from gross errors in operation. For example, a low-temperature shift of -11°F or a high-temperature shift of $+11^{\circ}\text{F}$ would cause shifts of the magnitude plotted here.

If your problem is caused by high or low developer activity, you should consider each of the potential causes. Also, be aware that the condition may have more than one cause, or one problem may be partially compensating for another. When you detect a developer-activity problem, it is good practice to verify all the operational conditions for the processor.

Chart 1



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Developer—Time Too Short or Too Long

The recommended developer time for Processes RA-4 is 45 seconds. If the developer time is too short or too long, it will affect development and the amount of dye formed.

Developer times that are too long will produce higher-than-normal LD, HD – LD, and BP density values.

Developer times that are too short will produce lower-than-normal LD, HD – LD, and BP density values.

Developer-time variations can occur in processors because of variations in electrical load and differences in motor temperature from a cold start to equilibrium. Electrical-load variations can be caused by other equipment (e.g., a heater) on the same power line. In some cases, you may need a voltage regulator on the processor drive motor to compensate for external voltage variations.

Mechanical problems, such as misaligned moving parts, can cause developer-time problems. Be sure that the transport is functioning properly. Extended developer times can also result from intermittent paper slippage in the developer tank. Use a stopwatch to measure the developer time, and compare it with the machine setting.

Developer—Temperature Too Low or Too High

The recommended developer temperature for Process RA-4 is $35 \pm 0.3^\circ\text{C}$ ($95.0 \pm 0.5^\circ\text{F}$) for KODAK EKTACOLOR RA Developer Replenisher or KODAK EKTACOLOR RA Developer Replenisher RT. For EKTACOLOR Developer Replenisher 12 (EKTACOLOR Developer Replenisher 161 in Europe) and EKTACOLOR PRIME Developer Replenishers, the recommended temperature is $37.8 \pm 0.3^\circ\text{C}$ ($100.0 \pm 0.5^\circ\text{F}$).

A developer temperature that is too low or too high affects development and the amount of dye formed. If the developer temperature is too high, the density values for LD, HD – LD, BP, and perhaps D-min will plot higher than normal. If the developer temperature is too low, the density values for LD, HD – LD, and BP will plot lower than normal.

If you suspect that the developer temperature is incorrect:

- Check that the temperature regulator is operating.
- Check that the developer had enough time to reach operating temperature before processing.
- Check that the temperature of the replenisher solution was not too low or too high.
- If your processor has more than one developer tank, check that the temperature is the same in all tanks. Check that the temperature within each tank is uniform from top to bottom and side to side.
- Check that the developer recirculation filter is not clogged. A clogged filter can prevent proper heating of the solution. Check for constricted circulation lines.

The temperature controller and the recirculation system—individually or in combination—can cause temperature problems. Replace the recirculation filters if they are clogged.

If the temperature of the developer replenisher is too low or too high, it may be affecting the temperature of the tank solution. If this occurs, you may need to provide more heat in the replenisher storage area or heat the replenisher before using it.

Check the developer temperature frequently, and adjust it as necessary. Also, check the developer temperature periodically while the processor is operating under full load. The heater may not be able to maintain the temperature as fresh replenisher and a maximum load of paper are entering the developer.

Developer—

Replenishment Rate Too Low or Too High

Developer activity varies directly with the replenishment rate. If the rate is too low, the LD, BP, and HD – LD density values will plot lower than normal. If the rate is too high, the density values for LD and BP will plot higher than normal. The amount of change that you see in control-strip plots due to incorrect replenishment depends on the developer-tank volume, processor speed, and the amount of paper processed.

The recommended replenishment rates are *starting points only*. The exact rate depends on the type of processor and replenisher mixing and storage conditions. It can also depend on how well you maintain operating conditions, such as development time and temperature. Determine your exact rate by monitoring the process with control strips and adjusting the rate as needed according to the control plots. **Do not** adjust the rate to “chase” small changes in the control plots. Once the process is in control, continue to use the rate you established; don’t change it unless processor utilization changes. Be aware that the rate of change after a replenishment-rate adjustment may be relatively slow; you may not see the full impact of a developer replenishment-rate change for several weeks.

To avoid replenishment problems, check the replenisher settings regularly to be sure that the correct rates and tank volumes are maintained.

If you suspect that replenishment is the problem:

- Check that the replenishment system is set correctly.
- Check that your calculations are correct if you set your replenishment rate for the average paper width being processed. Does the paper width vary seasonally? Check your replenishment rate by using this calculation.

$$\begin{array}{ccccccc} \text{Flow} & & \text{Processor} & & \text{Paper} & & \text{Replenishment} \\ \text{Rate} & = & \text{Speed} & \times & \text{Width} & \times & \text{Rate} \\ (\text{mL/min}) & & (\text{m/min or ft/min}) & & (\text{m or ft}) & & (\text{mL/m}^2 \text{ or ft}^2) \end{array}$$

- Check that the processor was receiving replenishment when you detected the problem.
- Check for a possible mechanical problem with the replenishment system. Is the system replenishing at a constant and repeatable rate?

If *underreplenishment* is the cause of the problem, adjust the replenishment rate to the correct rate. To correct the underreplenished processor tank condition, remove enough developer tank solution so that you can add replenisher in 5- to 10-percent increments of tank volume. Repeat if needed to correct the tank condition. After each addition, recirculate the developer for approximately 10 minutes before you process another control strip.

If *overreplenishment* is the cause of the problem, adjust the replenishment rate to the correct rate. To correct the overreplenished processor tank condition, remove enough developer tank solution so that you can add water and starter to bring the process back into control. Add one part starter to 11 parts water. If the process is not far out of control, add the water and starter in 5-percent increments of tank volume. If the process is grossly out of control, add water and starter in 10-percent increments. After each addition, recirculate the developer for approximately 10 minutes before you process another control strip. If the process is still out of control after you have added water and starter equivalent to 20 percent of the tank volume, replace the tank solution with a fresh mix.

Developer—Fresh-Tank Mixing Error—Too Little or Much Starter

Using *too little* starter in a fresh developer mix will increase developer activity. You will see this in the control plots as an increase in the LD and HD – LD density values.

Using *too much* starter for a fresh developer tank solution decreases developer activity. You will see this in the control plots as a decrease in the LD, HD – LD, and BP density values.

To avoid these fresh-tank mixing errors, carefully follow the directions provided with the developer.

If you know the amount of starter that was left out, you can add the missing amount. If you added too much starter or do not know the amount of the error, it will be difficult to correct the problem without a chemical analysis. Replace the tank solution with a fresh mix.

Developer—Mixing Error—Incorrect Water/ Replenisher Ratio

Developer activity is affected by a mix that is prepared with too little replenisher and topped with water, or with too little water and topped with replenisher.

Using too much water and too little replenisher has the greater effect. You will see this as lower-than-normal LD, HD – LD, and BP values in the control plots.

If you use too much replenisher and too little water, the effect in the control charts will be slight.

Review your mixing procedures and verify the mix-tank calibration. Follow the mixing order in the instructions provided with the chemicals.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Replenisher Mixing Error—Too Little or Too Much Part A

Using the wrong amount of any of the developer components affects developer activity. Too little Part A causes high activity; too much Part A causes low activity.

Omitting Part A entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for possible sources of error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer Replenisher Mixing Error—Too Little or Too Much Part B

Using the wrong amount of any of the developer components affects developer activity.

Omitting Part B entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for sources of possible error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Replenisher Mixing Error—Too Little or Too Much Part C

Using the wrong amount of any of the developer components affects developer activity. Too little Part C causes low activity; too much Part C causes high activity.

Omitting Part C entirely usually results from human error. However, the chance of leaving out just a portion increases if you split the packaged developer to mix a smaller volume. Errors of 5 to 10 percent will affect the control plots. Be sure that your measuring device is accurate and that you use it correctly. Check that you have calculated the amounts correctly, and that you added the correct amount.

To reduce errors, always use accurate measuring equipment. Graduated cylinders calibrated in millilitres, not ounces, are the most accurate. If you use an automatic mixer, be sure it is properly calibrated for the volumes being mixed. Review mixing procedures for sources of possible error.

Because it is very difficult to determine the exact cause or amount of this type of mixing error without chemical analysis, replace the solution with a fresh mix.

Developer—Contamination With Bleach-Fix

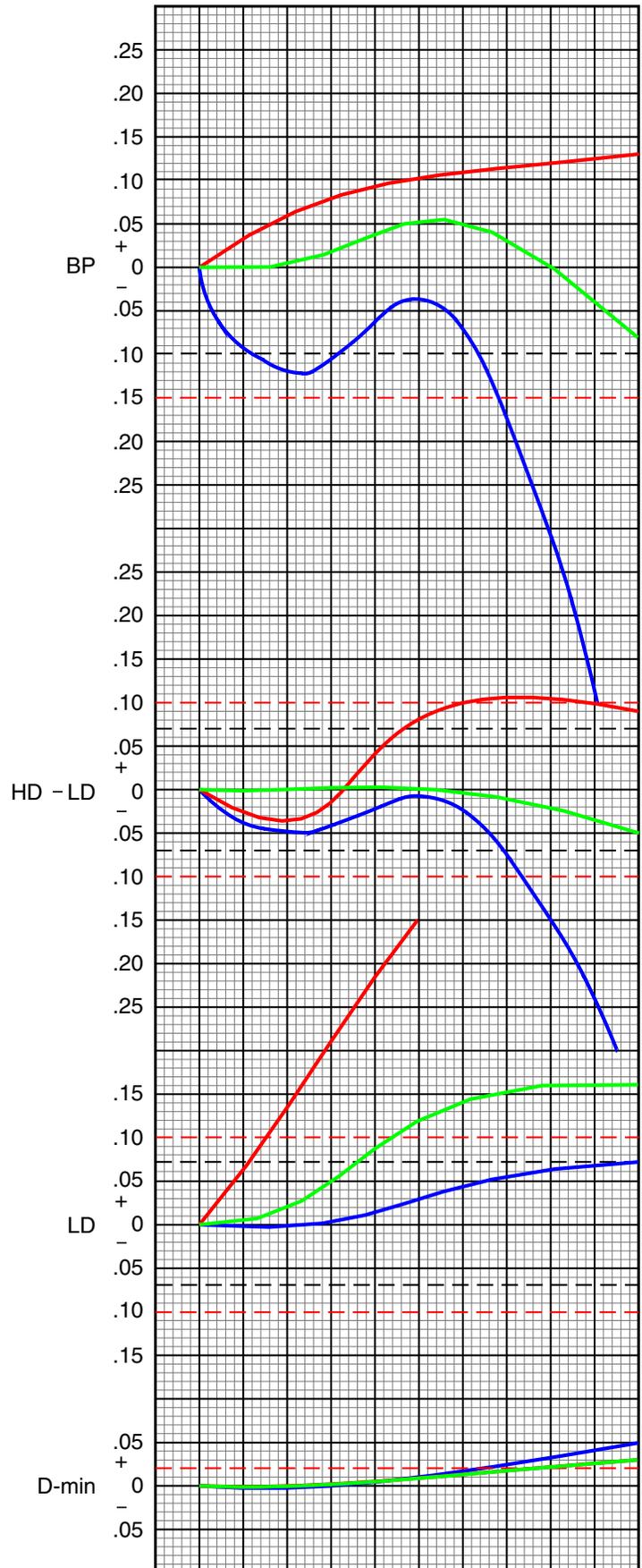
Chart 2 demonstrates that very small amounts of thiosulfate (also called hypo) from the bleach-fix will contaminate the developer. As little as 0.1 mL of bleach-fix per litre of developer can put a process out of control. If the developer is contaminated with bleach-fix, you will see a severe color change in the prints and large shifts in the control plots. You will also see an increase in D-min.

The chart shows the typical plot pattern that results from bleach-fix contamination of a developer tank. The degree of contamination is severe in this example; the most severe contamination shown is at 2.4 mL of EKTACOLOR RA Bleach-Fix NR Replenisher per litre of developer.

Possible causes of bleach-fix contamination are bleach-fix splashed into the developer when the racks are raised or mixing developer with equipment that contains a small amount of bleach-fix. Check for any procedures that might cause splashing during mixing or processing. If possible, use separate mixing tanks for developers, and wash all mixing equipment thoroughly before reusing it.

Stop production until you find the source of the contamination. A developer contaminated with bleach-fix or fixer cannot be salvaged; replace it with a fresh mix.

Chart 2



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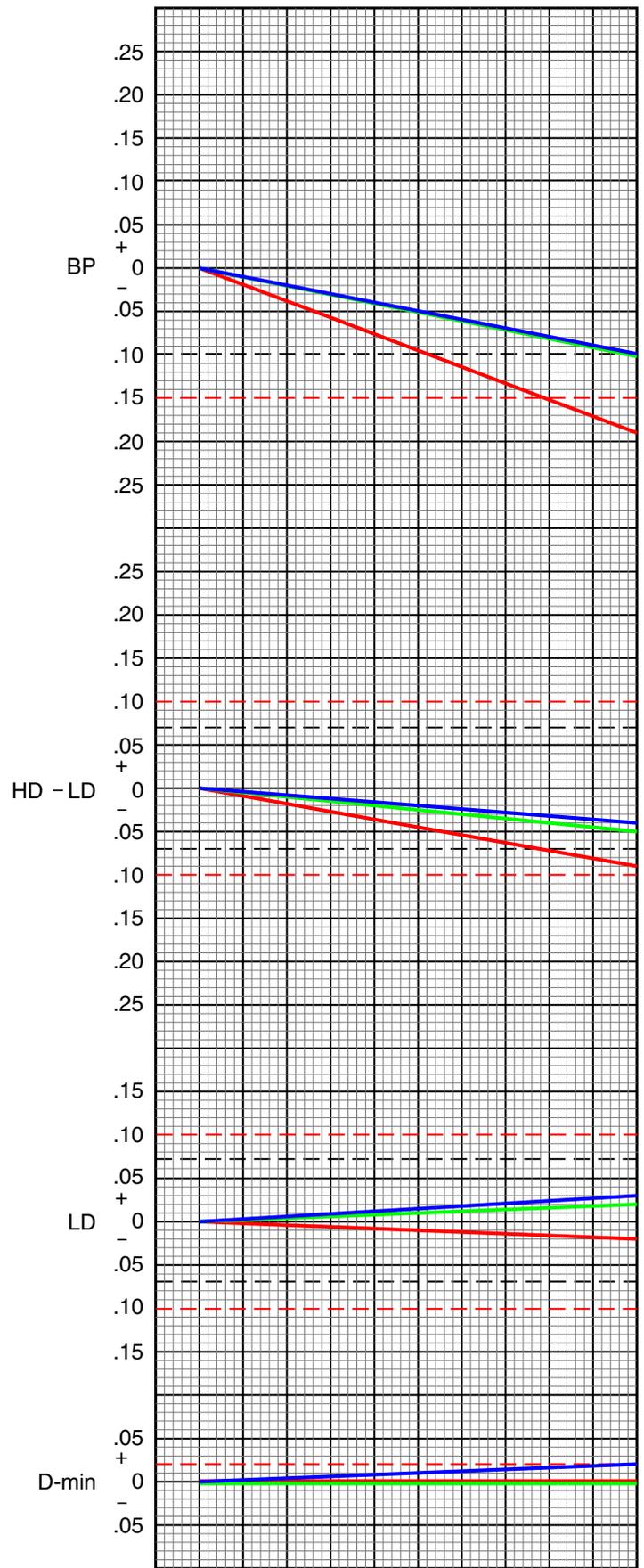
Bleach-Fix—Leuco-Cyan Dye

Chart 3 demonstrates controls plots that can result from a problem in the bleach-fix. Leuco-cyan dye is a colorless form of the cyan dye caused by poor bleach-fix performance. Prints with leuco-cyan dye will appear to have a reddish cast in the higher neutral-density regions of the images.

The most common cause of a leuco-cyan dye condition is low bleach-fix pH. This can result from overreplenishment of the bleach-fix tank or from incorrect pH adjustment if you make any manual pH adjustments. You may also observe leuco-cyan dye when you start up with a fresh mix.

If your process control plots indicate low cyan densities, verify the bleach-fix replenishment rates and avoid overreplenishment. Following the test procedure on the following page can verify the presence and significance of a leuco-cyan dye problem.

Chart 3



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Rebleaching Test for Leuco-Cyan Dye

Leuco-cyan dye is a colorless form of cyan dye. You can recover the dye by rebleaching the control strip. The degree of recovery is a measure of the amount of leuco-cyan dye. To test for leuco-cyan dye, follow these steps.

1. Zero your densitometer. Measure and record the BP density of your control strip.
2. Rebleach the control strip for 2 minutes in a *known good bleach* (i.e., a properly constituted Process C-41 bleach or a solution made from KODAK Farmer's Reducer, Part A).
3. Wash the control strip for several minutes and allow it to dry.
4. Rezero your densitometer. Read the BP density of the control strip again.
5. To calculate the change in density readings, subtract the reading in step 1 from the reading in step 4. If the difference is greater than + 0.06, a leuco-cyan dye problem exists.
6. Check the pH of the bleach-fix. Use ammonium hydroxide to adjust the pH to 6.25 ± 0.25 . Verify replenishment rates and mixing methods.



Caution

AMMONIUM HYDROXIDE IS CORROSIVE. Ammonium hydroxide requires careful handling; it is strongly corrosive and can cause serious harm to the skin and eyes; it will damage clothing. For your safety, see the Material Safety Data Sheet for handling and precautionary information. Observe *all* CAUTION statements. Avoid contact with skin or clothing by solution or vapors. Use a ventilation hood to avoid exposure to vapors. **Do not** weigh this chemical in an aluminum container.

Developer—Oxidation

When developer is exposed to air, it reacts with oxygen. To protect the developing agent, developers contain preservatives that react with oxygen. However, prolonged exposure to air will eventually deplete the preservatives and cause the developing agent to oxidize. Oxidation of the developing agent causes decreased developer activity and precipitate formation.

It is difficult to produce a representative plot pattern for the effects of developer oxidation, because it depends on the degree of aeration of the tank. Also, if you adjust your developer replenishment rate in an attempt to reduce the process control bias, you may be masking the impact of the oxidation. Generally, you will see an increase in BP, HD – LD, and D-min in the control plots.

The most common causes of oxidation are excessive agitation and low processor utilization. Excessive agitation—e.g., from long or too rapid mixing or too much agitation in the processor—forces air into the solution. A faulty processor recirculation pump can also suck air into the solution. Foaming may indicate that the recirculation system is leaky and is sucking air.

Oxidation is a more common problem in roller-transport processors than in other type of processor, because the rollers constantly expose large areas of solution to the air. Oxidation is also more likely in roller-transport processors because they often have low utilization, which means that the solution is exposed to air for long periods without replenishment. Without replenishment, preservatives in the developer are not replaced as they would be with normal utilization. Evaporation is also higher in low-utilization processors, and leads to overconcentration of the developer. Overconcentration may offset some of the effects of the oxidation and mask the condition.

Minimize oxidation by turning off the processor when it is not in use. In roller-transport processors, use solutions that contain extra protection against oxidation, such as KODAK EKTACOLOR RA Developer Replenisher RT.

Check for excessive air flow over the processor developer tanks and developer replenisher storage tanks. Use floating lids on storage tanks. Avoid overmixing and excessive agitation.