1 *KODAK FLEXICOLOR* CHEMICALS

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

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 per roll

In all of these factors, KODAK Chemicals are superior or competitive.

KODAK Chemicals are readily available. When you purchase KODAK Chemicals, you are supported by a reliable network of expertise: Kodak field representatives, Kodak Service and Support, Kodak Information Center, Kodak Environmental Services, and many helpful publications and other services.

KODAK FLEXICOLOR Chemicals offer you the following features and benefits.

FEATURES	BENEFITS
• All-liquid concentrates	• Easy mixing
• Available in a wide variety of sizes	• Sizes convenient for all users—minilabs, large processing labs, professional labs, advanced amateurs, etc.
• Formulated to provide excellent performance when mixed with a variety of water supplies	• Quality of local water supply not critical
• Low developer replenishment rates with FLEXICOLOR Developer Replenisher LORR	• Less mixing • One-half the replenishment rate of FLEXICOLOR Developer Replenisher • Less effluent discharged—more favorable environmental impact • Chemical savings
• Efficient bleaching with FLEXICOLOR Bleach III Replenisher	• Robust bleaching performance • Reduced environmental impact
• Packaged bleach regenerator available	• One-part concentrate for easy mixing • Reduced chemical costs • HV Regenerator specifically formulated for high-volume photofinishers • Less COD, iron, chelates, and ammonia discharged to treatment plant
• Odorless solution with FLEXICOLOR RA Bleach Replenisher NR	• Better workplace environment
• ELECTROSILVER Fixer and Replenisher LORR available for in-line silver recovery	• Chemical cost savings • Very low replenishment rate • Less effluent discharged • More efficient silver recovery
• Excellent physical performance, and elimination of formaldehyde from workplace with FLEXICOLOR Final Rinse and Replenisher	• Fewer drying marks • Less makeovers and retouching • No need for formaldehyde training or associated record keeping required by OSHA
• Rapid-access cycle time for some minilabs with FLEXICOLOR RA Chemicals	• Faster turnaround time for customer orders

WHAT *KODAK* CHEMICALS ARE AVAILABLE?

KODAK FLEXICOLOR Chemicals are available in a variety of sizes to meet the needs of all types of processing operations. Select the best chemical and the right sizes that best meet your business needs.

The chemicals and sizes given apply to the U.S. region. Other regions may supply these chemicals in different sizes.

KODAK FLEXICOLOR Chemicals for Continuous, Roller-Transport, and Rack-and-Tank Processors

KODAK FLEXICOLOR Developer Replenisher LORR

This developer offers you the same performance as KODAK FLEXICOLOR Developer Replenisher except with lower replenishment rates. This has many benefits for your lab—developer effluent discharge reduction of approximately 50 percent, less chemical mixing, and lower cost per square foot of film processed. Processor utilization is not a factor; you can use FLEXICOLOR Developer Replenisher LORR at any utilization level. Primarily recommended for use in continuous processors.

- *For Large-Volume Automatic Processors:* Available in sizes to make 50 and 100 U.S. gallons.
- *For Small- to Medium-Volume Automatic Processors:* Available in sizes to make 5 and 10 litres and 25 U.S. gallons (two 12.5-gallon sizes).

KODAK FLEXICOLOR Developer Starter LORR

Use this starter to prepare a fresh tank solution from KODAK FLEXICOLOR Developer Replenisher LORR.

- *For All Processors:* Available as a 1-quart concentrate to make 8.3 U.S. gallons of developer tank solution.

KODAK FLEXICOLOR Developer Replenisher

This developer is a long-time standard for processing Kodak color negative films in Process C-41. To make a fresh tank solution from this replenisher, use *only* KODAK FLEXICOLOR Developer Starter. Primarily recommended for use in roller-transport and rack-and-tank processors.

- *For Large-Volume Automatic Processors:* Available in a size to make 75 U.S. gallons.
- *For Small- to Medium-Volume Processors:* Available in sizes to make 5 and 25 U.S. gallons (two 12.5-gallon sizes).

KODAK FLEXICOLOR Developer Starter

Use this starter *only* with KODAK FLEXICOLOR Developer Replenisher.

- *For All Processors:* Available as a 1-quart concentrate to make 17.8 U.S. gallons of developer tank solution.

KODAK FLEXICOLOR Bleach III Replenisher

FLEXICOLOR Bleach III offers excellent performance with less iron and chelates. Use this bleach as a replenisher or mix it with starter to prepare a tank solution. You can also regenerate bleach overflow to reduce chemical costs and chemical discharge.

- *For Large-Volume Automatic Processors:* Available in two parts in a size to make 75 U.S. gallons. (Both parts are required to prepare replenisher solution.)
- *For Small- to Medium-Volume Processors:* Available in sizes to make 5 and 12.5 U.S. gallons.

KODAK FLEXICOLOR Bleach Starter

Use this starter to prepare bleach tank solution with FLEXICOLOR Bleach III Replenisher. This product is odorless, non-corrosive, and non-foaming for easy use.

- *For All Processors:* Available as a 1-gallon concentrate to make 20 U.S. gallons of Bleach III tank solution.

KODAK FLEXICOLOR Bleach III Regenerator

By regenerating FLEXICOLOR Bleach III tank overflow with this regenerator, you can reduce bleach chemical costs and the amount of ammonia, iron, and COD in bleach effluent. Available as a one-part concentrate for easy mixing.

- *For Large-Volume Automatic Processors:* Available in sizes to prepare 25 U.S. gallons (two 12.5-gallon sizes) and 75 U.S. gallons of replenisher from overflow.
- *For Small- to Medium-Volume Automatic Processors:* Available in a size to make 5 U.S. gallons.

KODAK FLEXICOLOR Bleach III HV Regenerator

Specifically formulated for high-volume photofinishers, this regenerator uses the same replenishment rate as Bleach III, but uses half as much concentrate to regenerate a given amount of overflow. Larger mix sizes can be made while keeping less inventory of product in stock.

- *For Large-Volume Automatic Processors:* Available in sizes to make 150 U.S. gallons replenisher from overflow and in 55 U.S. gallon drums.

KODAK FLEXICOLOR Fixer and Replenisher

Dilute this concentrate for use as replenisher or tank solution.

- *For Large-Volume Automatic Processors:* Available in sizes to make 25 and 75 U.S. gallons.
- *For Small- to Medium-Volume Automatic Processors:* Available in sizes to make 5 litres and 1, 5, and 25 U.S. gallons.

KODAK ELECTROSILVER Fixer and Replenisher LORR

This solution was designed for labs that desilver fixer electrolytically in a “closed loop” system. With this fixer, routine analysis of pH and sulfite are not required. This product reduces replenishment rates and effluent volume for loading of effluent components, such as ammonia.

- *For Large-Volume Automatic Processors:* Available in sizes to make 75 and 150 U.S. gallons.

KODAK FLEXICOLOR Final Rinse and Replenisher

This final rinse is designed with state-of-the-art surfactants to reduce deposits and drying marks on processed color negative films. As a result, both the processed film and the seasoned working tank solution will be cleaner. This means less maintenance and less frequent dumping of working tanks. Because the new final rinse contains no stabilizing agent, labs will not need to provide formaldehyde training or do the associated record-keeping required by OSHA guidelines.

- *For Large-Volume Automatic Processors:* Available in a size to make 75 U.S. gallons.
- *For Small- to Medium-Volume Automatic Processors:* Available in sizes to make 5 and 10 litres and 12.5 U.S. gallons.

KODAK FLEXICOLOR Stabilizer III and Replenisher

Stabilizer III provides excellent performance for reducing drying marks, and robust image stability for films requiring stabilization.

- *For Large-Volume Automatic Processors:* Available in a size to make 75 U.S. gallons.
- *For Small- to Medium-Volume Automatic Processors:* Available in sizes to make 5 and 12.5 U.S. gallons.

KODAK FLEXICOLOR Chemicals for Processors with In-Line Replenishment

KODAK FLEXICOLOR AR Developer Replenisher

Use this developer in processors that use automatic in-line replenishment systems. Three parts are required for a developer replenisher mix, and are available separately. To make a tank solution from this replenisher, use *only* FLEXICOLOR Developer Starter.

- *Part A available in a 5-gallon flexible container.*
- *Part B available in a 1-gallon flexible container*.
- *Part C available in a 1-gallon flexible container.*

KODAK FLEXICOLOR Developer Starter

Use this starter *only* with KODAK FLEXICOLOR AR Developer Replenisher or FLEXICOLOR Developer Replenisher.

- *For All Processors:* Available as a 1-quart concentrate to make 17.8 U.S. gallons of developer tank solution.

KODAK FLEXICOLOR Bleach III Replenisher

This chemical is supplied in a flexible plastic container.

- *Available in a size to make 12.5-gallons.*

KODAK FLEXICOLOR Bleach Starter

Use this starter to prepare bleach tank solution with FLEXICOLOR Bleach III Replenisher. This product is odorless, non-corrosive, and non-foaming for easy use.

- *For All Processors:* Available as a 1-gallon concentrate to make 20 U.S. gallons of Bleach III tank solution.

KODAK FLEXICOLOR Fixer and Replenisher

This chemical is supplied in a flexible plastic container.

- *Available in a size to make 12.5-gallons.*

KODAK FLEXICOLOR AR Stabilizer III and Replenisher

Use this stabilizer in roller-transport and rack-and-tank processors. It provides robust image stability for films requiring stabilization and excellent performance for reducing drying marks.

- *Available in a 5-gallon flexible container.*

KODAK FLEXICOLOR Chemicals for Minilabs

KODAK FLEXICOLOR Developer Replenisher LORR

This developer has low replenishment rates that help reduce developer effluent discharge by as much as 50 percent. Lower replenishment rates mean less chemical mixing and lower cost per roll of film processed. Use *only* FLEXICOLOR Developer Starter LORR to prepare a fresh tank solution with FLEXICOLOR Developer Replenisher LORR.

- *Available in sizes to make 5 and 10 litres and 25 U.S. gallons (two 12.5-gallon sizes).*

KODAK FLEXICOLOR Developer Starter LORR

Use this starter to prepare a fresh tank solution from FLEXICOLOR Developer Replenisher LORR.

- *Available in a size to prepare 8.3 U.S. gallons of developer tank solution from developer replenisher*.

KODAK FLEXICOLOR Bleach III NR Replenisher

For minilabs using Process C-41B, this bleach offers reduced cost per roll of film and reduced replenishment rates and volume of effluent discharged. It requires no mixing; it is packaged ready to use.

- *Available in a 5-litre size.*

KODAK FLEXICOLOR RA Bleach Replenisher NR

This bleach was designed for use *only* with minilabs that use Process C-41RA. It requires no mixing; it is packaged ready to use. This bleach is also odorless.

- *Available in a 5-litre size.*

KODAK FLEXICOLOR Bleach Starter

Use this starter to prepare a bleach tank solution with FLEXICOLOR Bleach III NR Replenisher or FLEXICOLOR RA Bleach Replenisher NR. This product is odorless, non-corrosive, and non-foaming for easy use.

- *Available as a 1-gallon concentrate to make 20 U.S. gallons of Bleach III NR tank solution or 8.3 U.S. gallons of RA Bleach NR tank solution.*

KODAK FLEXICOLOR Fixer and Replenisher

Use this fixer for Process C-41 or C-41B.

- *Available in sizes to make 5 litres and 5 and 25 U.S. gallons.*

KODAK FLEXICOLOR RA Fixer and Replenisher

This fixer was designed for use *only* with minilabs that use Process C-41RA.

- *Available in sizes to make 5 and 10 litres.*

KODAK FLEXICOLOR Final Rinse and Replenisher

This final rinse is designed with state-of-the-art surfactants to reduce deposits and drying marks on processed color negative films. It also reduces the potential for biological growth in the mixed solution. As a result, both the processed film and the seasoned working tank solution will be cleaner. This means less maintenance and less frequent dumping of working tanks. Because the new final rinse contains no stabilizing agent, labs will not need to provide formaldehyde training or do the associated record-keeping required by OSHA guidelines.

- *Available in sizes to make 5 and 10 litres and 12.5 and 75 U.S. gallons.*

KODAK FLEXICOLOR Chemicals for Rotary-Tube Processors, Small Tanks, and Unreplenished Sink Lines

These chemicals are designed for use in unreplenished batch systems—e.g., small tanks, rotary tubes, and small-volume sink lines. They are ready to use as mixed without adding starter.

Note: For higher-volume replenished sink-line systems, it is more practical to use larger chemical sizes. You can prepare tank solutions of developer and bleach by adding the appropriate starters to the replenisher solutions.

KODAK FLEXICOLOR Developer

Use this developer in unreplenished systems. No starter is needed.

- *Available in a size to make 1 U.S. gallon.*

KODAK FLEXICOLOR Bleach III

Use this bleach full-strength in small tanks and tube-type processors without replenishment.

- *Available in a size to make 1 U.S. gallon.*

KODAK FLEXICOLOR Fixer and Replenisher

Mix according to the directions for use as a working solution.

- *Available in sizes to make 1 and 5 U.S. gallons.*

KODAK FLEXICOLOR Stabilizer III

Mix according to the directions for use as a working solution.

- *Available in a size to make 1 U.S. gallon.*

CHEMICAL TERMS

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

Chemical Concentrates—Chemicals that are used to make replenisher solutions and fresh tank solutions.

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

Regenerator—Concentrate added to tank solution overflow to convert it for reuse as replenisher solution.

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—Solution added to diluted chemical concentrates 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."

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.

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:

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, extension 10. 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 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 Phisoderm, Sulfo Hand Cleaner, or pH6). 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 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.

More Information

If you have environmental or safety questions about Kodak products or services, contact Kodak Environmental Services at 716-477-3194, between 8 a.m. and 5 p.m. (Eastern time).

Kodak also maintains a 24-hour health hotline to answer questions about the safe handling of photographic chemicals. If you need health-related information about Kodak products, call 716-722-5151.

For questions concerning the safe transportation of Kodak products, call Kodak Transportation Services at 716-722-2400.

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**.

MIXING CHEMICALS

For the most current mixing instructions, follow those packaged with the chemicals or on the label of the container. Be sure to follow all safety precautions and the handling recommendations described earlier. Table 1-1 summarizes the mixing instructions for FLEXICOLOR Chemicals.

Table 1-1 Mixing KODAK FLEXICOLOR Chemicals

Chemical	Comments
Developer Developer Replenisher Developer Replenisher LORR	Mix the developer solution at 21 to 38°C (70 to 100°F). The mixing order is important with developers and developer replenishers because Parts A and B contain the preservatives. Therefore, add Part C only after you have mixed Parts A and B. It is not necessary to mix each part for a long time. You can add the parts in fairly rapid succession without causing a problem. Agitate enough to mix the developer completely in less than 5 minutes without introducing a lot of air into the developer solution. The solution will be clear and colorless after you add Parts A and B; it will be amber after you add Part C.
Bleach III Bleach III Replenisher Bleach III Regenerator Bleach III HV Regenerator	Mix at 21 to 38°C (70 to 100°F). The chemicals mix easily. Lengthy agitation does not harm bleaches; it provides beneficial aeration. Fresh bleach and replenisher should be colorless and clear (no solids) after Part A is added. After both Parts A and B have been mixed, the bleach should be greenish yellow, and should not contain any solids. Visual appearance will change after the bleach overflow is regenerated; the solution will be darker.
Bleach III NR Replenisher RA Bleach Replenisher NR	These bleaches do not require mixing; they are ready to use as supplied. The color of the Bleach III NR should be a greenish yellow. The color of the RA Bleach NR should normally be dark green-yellow.
Fixer Fixer and Replenisher ELECTROSILVER Fixer and Replenisher LORR RA Fixer and Replenisher	Mix at 21 to 38°C (70 to 100°F). Provide moderate agitation so that mixing is complete in approximately 5 minutes. Although fixers are not as oxygen-sensitive as developers, avoid aeration. In extreme cases, too much agitation can cause sulfurization. Mixed fixer solution is clear and colorless to light yellow.
Final Rinse and Replenisher Stabilizer III and Replenisher	Mix at 21 to 38°C (70 to 100°F). FLEXICOLOR Stabilizer III and Final Rinse and Replenishers contain a wetting agent that can produce a lot of foam if agitation is too vigorous. Mixed final rinse and stabilizer are clear and colorless.

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

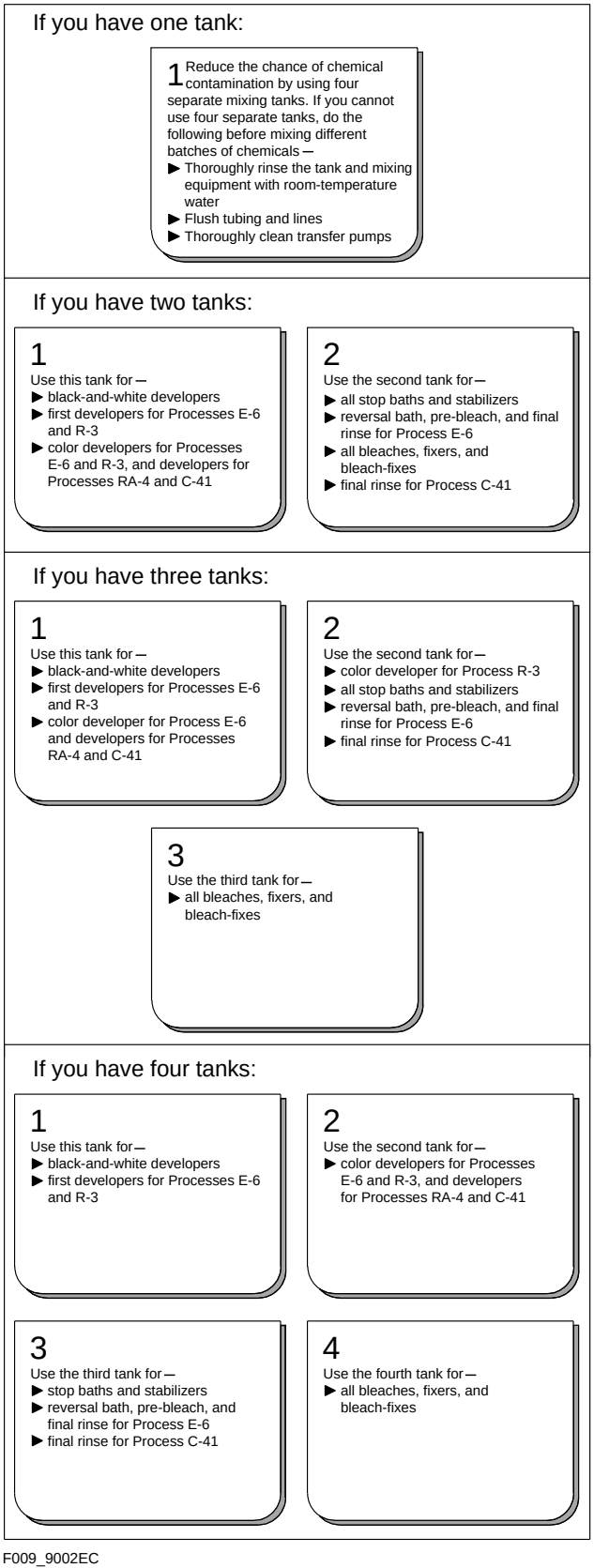
To reduce the possibility of contamination, take care to avoid dripping solution into other tanks when you remove racks for cleaning, avoid splashing by not agitating too vigorously, and check that processing and mixing equipment and plumbing are made of suitable material. If possible, use a separate 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. Figure 1-1 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 only chemicals for REVERSAL processes, use two mix tanks: one for the first and color developers and one for all other solutions. Three mix tanks are preferable: one for the developers, one for the bleach and fixer, 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.

Figure 1-1 Configurations for Chemical Mixing Tanks



F009_9002EC

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 1-2. If you use well water, be sure to have the water tested for the impurities listed in Table 1-2.

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 1-2 Practical Limits of Impurities for Water Used in Photographic Processing

Impurity	Acceptable Limit or Range (ppm)
Color, suspended material	None
Dissolved solids	1000 (for washes) 250 (for preparing solutions)
pH	6.5 to 8.5
Hardness, as $CaCO_3$	40 (preferable) to 150
Copper, iron, manganese	0.10 each
Chlorine, as free hypochlorus acid	2
Chloride	100
Bicarbonate	150
Sulfate	200
Sulfide	0.10
Silica	20

Note: If analysis of water shows a marked deviation from the amounts in Table 1-2, 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 polyethylene, are also acceptable.

Other Solutions—Bleach and fixer solutions rapidly corrode brass, copper, and lower grades of stainless steel. Avoid contact of these metals with bleach and fixer. For FLEXICOLOR Bleach III, FLEXICOLOR Fixer, and wash tanks, the best material is Type 316 stainless steel. For FLEXICOLOR RA Bleach and FLEXICOLOR RA Fixer, the preferred construction material is titanium. Several plastic materials, such as polyethylene, are also acceptable as construction materials for processing equipment.

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 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 film.
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 (follow the instructions provided with this product). Rinse racks and tanks thoroughly before you refill the tanks.

Removing Biological Growth—Biological growth can occur in final rinse and wash tanks. This is a potential source of dirt. To remove biological growth:

1. Empty the processing solution tank. Dispose of waste solutions according to local 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 tank 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 800-242-2424, extension 60. In Canada, call 800-465-6325. In other regions, contact Kodak in your country. For information on controlling biological growth, request a copy of KODAK Publication CIS-3, *Biocides for Photographic Solution Tanks and Wash Water*.

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 5 to 30°C (40 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 chemicals 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. To reduce the effects of oxidation, store solutions in amounts that you can use at one time. For example, if you open a 10-gallon-size container, mix the entire amount, and then store the solution in closed one-gallon containers. Each time you need more chemicals, open a bottle and use the entire amount. The remaining mix stored in separate containers is not exposed to air.

When you store solutions in plastic bottles, fill the bottle close to the top and then squeeze the bottle gently before you cap it to raise the chemical level to the top of the neck.

Flexible plastic containers minimize oxidation because air is excluded when the plastic container collapses as chemicals are removed. 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 1-3.

Table 1-3 Storage Times for KODAK FLEXICOLOR Chemicals

Mixed Solution (Fresh)	Full Stoppered Glass Bottles	Tanks with Floating Covers
Developer or Developer Replenisher	6 weeks	4 weeks
Bleach III Replenisher	8 weeks	8 weeks*
Bleach Tank Overflow awaiting regeneration	8 weeks	8 weeks*
Other Solutions	8 weeks	8 weeks

* Because aeration is beneficial to Bleach III Replenisher, do not use floating lids.

CHECKING CHEMICALS AND CHEMICAL MIXES

Fresh FLEXICOLOR 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 FLEXICOLOR Chemicals and solutions. You can also check your mixes for possible mixing errors by using specific-gravity measurements.

Table 1-4 Characteristics of KODAK FLEXICOLOR Chemicals

Chemical	Part	Normal Appearance	Comments
Developer Developer Replenisher Developer Replenisher LORR	A	Clear, colorless to very pale yellow; odorless	A crystalline precipitate may appear in parts that are kept too long (more than 2 years) and/or exposed to cold temperatures. If color and odor are normal, Part A is usable if the crystalline material dissolves upon mixing. Extended mixing and heat may be needed before adding Parts B and C. However, be sure mixture is no warmer than 38°C (100°F) when Part C is added.
	B	Clear, colorless; odorless	
	C	Clear; color varies from light yellow to yellow	The color range is due to different levels of sulfite. Absence of sulfur dioxide odor means the preservative is exhausted. If the solution turns color or becomes opaque, or if there is a precipitate, do not use it.
Developer Starter Developer Starter LORR		Clear, colorless to very pale yellow; faint odor	
Bleach III (1-gallon size) Bleach III Replenisher	A	Clear, colorless to very pale yellow; odor of acetic acid (vinegar)	Occasionally you may see a very small amount of light yellow-brown sediment in the mix. This material should not affect processing.
	B	Greenish-yellow; slight ammonia odor	When exposed to cold (below 4° C/40° F), the solution may form a green-brown precipitate. This material will not redissolve, do not use.
Bleach III Regenerator Bleach III HV Regenerator		Greenish-yellow; slight ammonia odor	When exposed to cold (below 4° C/ 40° F), the solution may stratify. Requires agitation to redissolve after reaching room temperature.
Bleach III NR		Greenish-yellow; slight ammonia odor	When exposed to cold (below 4° C/ 40° F), the solution may form a green-brown precipitate. This material will not redissolve, do not use.
RA Bleach NR		Dark yellowish-green; no odor	When exposed to cold (below 4° C/40° F), the solution may form a green-brown precipitate. This material will not redissolve, do not use.
Bleach Starter		Clear, colorless; odorless	
Fixer ELECTROSILVER Fixer LORR RA Fixer		Clear, colorless to very pale yellow; odor of ammonia	Age and/or exposure to high temperature can cause sulfurization. When a white to light yellow sediment forms, the solution becomes more yellow, and a musty odor (sulfur) is noticeable along with the acetic acid odor. A severely degraded fixer may have a large amount of precipitate and an odor of hydrogen sulfide (i.e., rotten-egg odor) and may appear dark; do not use it.
Final Rinse and Replenisher		Very light to light cyan	
Stabilizer III and Replenisher		Clear, colorless; slight odor of formaldehyde	

Check Your Mixes with Specific-Gravity Measurements

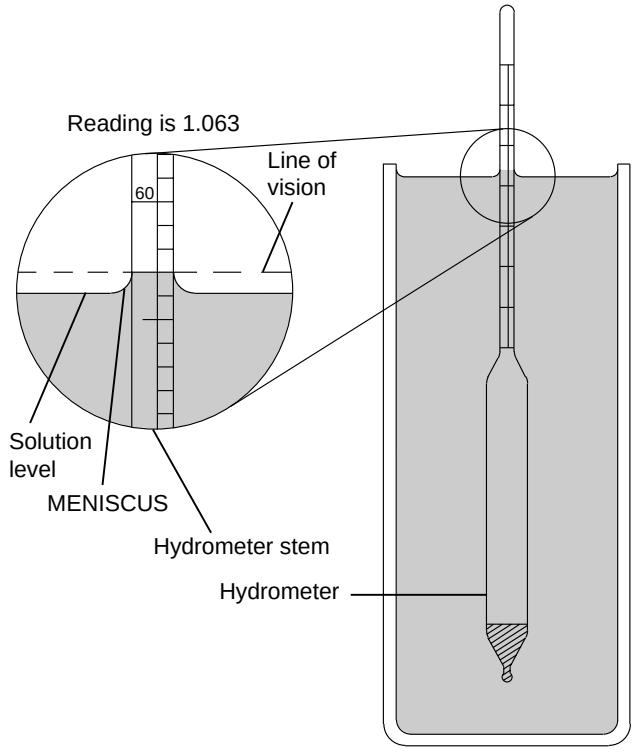
Specific gravity provides a convenient way to measure the total dissolved material in a solution. Its primary use with FLEXICOLOR Chemicals is to check for mixing errors. Specific gravity is the ratio of the mass of a liquid to the mass of an equal volume of water. The amount and type of materials in a solution determine the specific gravity.

How to Measure Specific Gravity—You can make specific-gravity measurements of your solutions with any hydrometer that meets the standard ASTM E100-95 (2001). The hydrometer should be marked in increments of at least 0.001 for an accuracy of ±0.0005. Although most hydrometers are calibrated at 15.5°C (60°F), they are useful at other temperatures. To measure the specific gravity of FLEXICOLOR Chemicals, follow the procedure described below. Typical specific-gravity ranges for fresh mixes are given in Table 1-5.

1. Fill a clean, dry 250 mL graduated cylinder to within 2.5 cm (1 in.) of the top with the solution you are measuring.
2. Adjust the solution to a temperature of 25 ±1°C (77 ±2°F). *Proper solution temperature is very important.*
3. Place the cylinder in a sink or tray to catch overflow.
4. Choose the correct hydrometer to match the approximate specific gravity of the solution.
5. Be sure that the hydrometer is clean and dry. Carefully lower the hydrometer into the solution. Let it bob up and down slightly. When it stops, read the number at the top of the meniscus (see Figure 1-2).
6. After making the measurement, discard the sample. To avoid contaminating solutions, **do not** return the sample to the tank.
7. Rinse the hydrometer and graduated cylinder thoroughly with water.

Note: Never take specific-gravity readings of solutions in the processor tanks. Inaccurate readings can result if the hydrometer bobs on the surface of the tank solution, or if the line of vision is not level with the hydrometer. Also, if you use the wrong hydrometer, it can sink to the bottom of the tank and break. Label hydrometer boxes to avoid confusion. **Do not** use tape labels on hydrometers.

Figure 1-2



F009_9003GC

Table 1-5 Specific-Gravity Values for KODAK FLEXICOLOR Chemicals

KODAK FLEXICOLOR Chemical	Specific Gravity at 25°C (77°F)		
	Fresh Tank	Seasoned Tank	Replenisher
Developer	1.034 to 1.040	1.036 to 1.044	1.034 to 1.040
Developer LORR	1.034 to 1.040	1.036 to 1.044	1.036 to 1.042
Developer LORR (5 and 10 litres)	1.034 to 1.040	1.036 to 1.044	1.034 to 1.040
Bleach III	1.030 to 1.040	1.030 to 1.060*	1.030 to 1.040
Bleach III HV	—	1.040 to 1.070*	—
Bleach III NR	1.035 to 1.045	1.040 to 1.070	1.045 to 1.055
RA Bleach NR	1.130 to 1.160	1.130 to 1.160	1.155 to 1.165
Fixer	1.055 to 1.100	1.055 to 1.100	1.080 to 1.090
RA Fixer	1.075 to 1.095	1.085 to 1.115	1.080 to 1.090
ELECTROSILVER Fixer LORR Tank 1 Tank 2	 1.075 to 1.115 — —	 — 1.085 to 1.125 1.095 to 1.135	 1.130 to 1.140 — —
Final Rinse	0.990 to 1.010	0.990 to 1.010	0.990 to 1.010
Stabilizer III	0.990 to 1.010	0.990 to 1.010	0.990 to 1.010

* The specific gravity of regenerated bleach replenisher should fall within this range.

EFFLUENT DISPOSAL

Effluent from KODAK FLEXICOLOR Chemicals consists of normal amounts of spent developer, bleach, desilvered fixer, wash water, and stabilizer. Desilver the fixer before you dispose of it. This effluent is compatible with and effectively treated by a municipal secondary waste-water treatment plant.

Because regulations define photographic effluent as an industrial waste discharge, most municipalities require a permit to discharge it to a waste-water treatment facility.

After efficient silver recovery, typical effluent from processes using KODAK FLEXICOLOR Chemicals has the characteristics listed in Table 1-6.

Table 1-6

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, or detergents	None
Flammable, explosive, or toxic materials	None

Concentration of other materials (e.g., ammonia, iron, sulfates, developing agents, and chemicals that have an oxygen demand [BOD, COD]) depends on factors such as replenishment and wash rates, type of processor, efficiency of squeegees, use of regeneration and pretreatment methods, dilution by effluent from other processes and non-processing waste water, etc. To characterize waste from your processing operation, we recommend that you have your effluent sampled by an analytical laboratory according to the method required by local discharge codes.

You can minimize photographic effluent by using squeegees where they are recommended, and by using the correct replenishment rates. Avoid making large 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 to the sewer along with your normal processing effluent.

Silver is regulated by many municipal sewer codes. Therefore, you should include silver recovery as a part of your normal processing. The primary recommendation for Process C-41 is to desilver the fixer effluent with an electrolytic recovery cell and then run the treated solution through a chemical-recovery cartridge to further reduce the silver concentration. For more information about choosing a silver-recovery method, see KODAK Publication No. J-212, *The Technology of Silver Recovery for Photographic Processing Facilities*.

If you have other questions about discharging FLEXICOLOR Chemicals or other environmental concerns, in the U.S., call the Kodak Information Center at 800-242-2424, extension 25. In Canada, call 800-465-6325. In other regions, contact Kodak in your country.

Other Effluent Disposal Methods—Although most labs discharge their effluent to a municipal waste-treatment plant, restrictions or lack of access to a treatment plant may require some labs to use an off-site disposal service.

You can have your processing effluent removed by a licensed disposal company. The KODAK RELAY Program is a disposal service for customers who use Kodak photographic chemicals. It is offered in conjunction with the Safety-Kleen Corporation. Participation in the RELAY Program can help you comply with waste-management regulations, especially when you cannot discharge processing effluent to a sewer.

To participate in the RELAY Program, contact your Kodak sales representative or call Kodak Environmental Services at 716-477-3194.

SOLID-WASTE RECYCLING

In the U.S., Kodak has established a series of recycling programs designed to help minilabs minimize the amount of solid waste that they send to landfills. These programs, administered by Kodak as part of the KODAK ENVIROWATCH System, include—

- KODAK Film Container Recycling Program
- KODAK FUN SAVER 35 Camera Recycling Program

The terms and conditions of each program are different. For more information about these programs, contact your Kodak sales representative, or call the Kodak Information Center at 800-242-2424 in the U.S.; in Canada, call 800-465-6325. In other regions, contact Kodak in your country.

For additional information on waste prevention and Kodak recycling programs, refer to KODAK Publication No. J-412, *Waste Prevention and Recycling for Photographic Processing Facilities*, or visit the Kodak website at **www.kodak.com/go/kes**.

SIMPLIFIED METRIC CONVERSION CHARTS

Volume, Length, and Weight

Because most laboratory measuring devices are calibrated in metric units, you can use the following table for converting U.S. units of volume, length, and weight to metric units. **Do not** use Table 1-7 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 1-7, 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.

You can use Table 1-8 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 fluid ounces, multiply 450 by .03382 = 15.22 fluid ounces).

Table 1-8

To Convert	Multiply By
Millilitres to Fluid ounces	0.03382
Fluid ounces 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

Table 1-7

U.S. Gallons to Litres										
gal	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	—	3.8	7.6	11.4	15.1	18.9	22.7	26.5	30.3	34.1
10	37.8	41.6	45.4	49.2	53	56.8	60.6	64.4	68.1	71.9
20	75.7	79.5	83.3	87.1	90.8	94.6	98.4	102.2	106	107.8
30	113.6	117.3	121.1	124.9	128.7	132.5	136.3	140.1	143.8	147.6
40	151.4	155.2	159	162.8	166.6	170.3	174.1	177.9	181.7	185.5
U.S. Fluid ounces 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

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 1-9

to °C	°F or °C	to °F
37.78	100	212.0
37.22	99	210.2
36.67	98	208.4
36.11	97	206.6
35.56	96	204.8
35.00	95	203.0
34.44	94	201.2
33.89	93	199.4
33.33	92	197.6
32.78	91	195.8
32.22	90	194.0
31.67	89	192.2
31.11	88	190.4
30.56	87	188.6
30.00	86	186.8
29.44	85	185.0
28.89	84	183.2
28.33	83	181.4
27.78	82	179.6
27.72	81	177.8
26.67	80	176.0
26.11	79	174.2
25.56	78	172.4
25.00	77	170.6
24.44	76	168.8
23.89	75	167.0
23.33	74	165.2
22.78	73	163.4

to °C	°F or °C	to °F
22.22	72	161.6
21.67	71	159.8
21.11	70	158.0
20.56	69	156.2
20.00	68	154.4
19.44	67	152.6
18.89	66	150.8
18.33	65	149.0
17.78	64	147.2
17.22	63	145.4
16.67	62	143.6
16.11	61	141.8
15.56	60	140.0
15.00	59	138.2
14.44	58	136.4
13.89	57	134.6
13.33	56	132.8
12.78	55	131.0
12.22	54	129.2
11.67	53	127.4
11.11	52	125.6
15.56	51	123.8
10.00	50	122.0
9.44	49	120.2
8.89	48	118.4
8.33	47	116.6
7.78	46	114.8

to °C	°F or °C	to °F
7.22	45	113.0
6.67	44	111.2
6.11	43	109.4
5.56	42	107.6
5.00	41	105.8
4.44	40	104.0
3.89	39	102.2
3.33	38	100.4
2.78	37	98.6
2.22	36	96.8
1.67	35	95.0
1.11	34	93.2
0.56	33	91.4
0.00	32	89.6
–0.56	31	87.8
–1.11	30	86.0
–1.67	29	84.2
–2.22	28	82.4
–2.78	27	80.6
–3.33	26	84.2
–3.89	25	77.0
–4.44	24	75.2
–5.00	23	73.4
–5.56	22	71.6
–6.11	21	69.8
–6.67	20	68.0
–7.22	19	66.2

to °C	°F or °C	to °F
–7.78	18	64.4
–8.33	17	62.6
–8.89	16	60.8
–9.44	15	59.0
–10.00	14	57.2
–10.56	13	55.4
–11.11	12	53.6
–11.67	11	51.8
–12.22	10	50.0
–12.78	9	48.2
–13.33	8	46.4
–13.89	7	44.6
–14.44	6	42.8
–15.00	5	41.0
–15.56	4	39.2
–16.11	3	37.4
–16.67	2	35.6
–17.22	1	33.8
–17.78	0	32.0
–18.33	–1	30.2
–18.99	–2	28.4
–19.44	–3	26.6
–20.00	–4	24.8
–20.56	–5	23.0
–21.11	–6	21.2
–21.67	–7	19.4
–22.22	–8	17.6
–22.78	–9	15.8

2 CONTINUOUS, ROLLER-TRANSPORT, AND RACK-AND-TANK PROCESSORS

KODAK FLEXICOLOR Chemicals are designed for processing all Kodak color negative films. This section provides the steps and conditions and replenishment rates for processing films in continuous, roller-transport, and rack-and-tank processors. It also describes methods for calculating average replenishment rates for a mix of film types and sizes.

You may be able to use two process options to reduce chemical costs and minimize effluent discharge (see *Processing Options*).

For information about monitoring your process, see Section 5, *Process Monitoring and Troubleshooting*.

Note: Do not process KODAK VERICOLOR Slide Film / SO-279/5072 in a processor using FLEXICOLOR Final Rinse and Replenisher. To provide optimum image-stability performance for these films, use FLEXICOLOR Stabilizer III and Replenisher.

USING PROCESS C-41

Steps and Conditions

The processing steps and conditions for Process C-41 in continuous, roller-transport, and rack-and-tank processors are similar to those for other types of processors.

Table 2-1 Steps and Conditions—Continuous, Roller-Transport, and Rack-and-Tank Processors—Process C-41

Solution/Step	Time* min:sec	Temperature °C (°F)	Comments
FLEXICOLOR Developer Replenisher LORR —or— FLEXICOLOR Developer Replenisher	3:15	37.8 ±0.15 (100.0 ±0.25)	Recirculate and filter. Agitate with nitrogen or turbulation. Film must be completely immersed.
FLEXICOLOR Bleach III Replenisher	4:20 to 6:30	38 ±3† (100 ±5)	Recirculate and filter. Agitate and aerate with oil-free air.
Wash	1:05	24 to 41‡ (75 to 105)	
FLEXICOLOR Fixer and Replenisher§ —or— ELECTROSILVER Fixer and Replenisher LORR	4:20	38 ±3† (100 ±5)	Recirculate and filter. Agitate with oil-free air, nitrogen, or turbulation.
Wash	3:15¶	24 to 41 (75 to 105)	
FLEXICOLOR Stabilizer III and Replenisher —or— FLEXICOLOR Final Rinse and Replenisher	1:05	24 to 41 (75 to 105)	
Dry	As needed	Not over 60 (140)	

* Includes immersion time and transfer time to the next tank. Keep transfer times to 20 seconds or less.

† If you increase the bleach and fixer times to 6:30 or longer, you can extend the bleach and fixer temperature range to 24 to 41°C (75 to 105°F).

‡ In some processors, a lower wash-water temperature may affect solution temperatures in adjacent tanks. Longer warm-up times may be needed. If it affects developer temperature during processing, you may need to use a higher wash-water temperature.

§ Use a two-stage (two-tank) countercurrent fixer, preferably with the same time in each tank. Agitation and filtration in each tank are required. If your processor has a single fixer tank, using in-line electrolytic desilvering will decrease the safety margin for adequate fixing.

¶ If your squeegees are efficient enough to maintain a low fixer carryover, you can reduce the wash time to 2:10.

Agitation

As chemicals in the emulsion are consumed, agitation helps remove byproducts and replace them with fresh solution. Inadequate agitation reduces solution activity. Agitation can be provided by solution turbulation or by a gaseous-burst system.

Developer—If your processor provides agitation by solution turbulation, the flow rate and the design of the turbulator bars must provide even agitation throughout the developer tank to optimize the HD – LD value of the control strip.

With gaseous-burst agitation systems, use only humidified nitrogen that has a purity of at least 99 percent. Do not use air; it will oxidize the developer. The gaseous-burst distributor must provide an even burst throughout the developer tank with an average bubble size of 4 mm in diameter (e.g., a "pea-size" bubble). The amount of gas pressure used varies with tank size and distributor design, but it should be enough to raise the solution approximately 1.5 cm (5/8 inch) during the burst. The burst should last 2 seconds with a frequency of 6 bursts per minute (2 seconds on/8 seconds rest). You can adjust the burst rate to optimize the HD – LD value.

Bleach—Agitation of the bleach is required to ensure good bleaching and prevent problems such as leuco-cyan dye and retained silver. You can provide agitation for the bleach by solution turbulation or by using a gaseous-burst system. Use oil-free compressed air for gaseous-burst systems at a frequency of 6 bursts per minute with a 2-second duration. For more information about aerating the bleach, see *Bleach Aeration in Process C-41* at the end of this section.

Fixer—You can provide agitation for the fixer by solution turbulation or by using a gaseous-burst system. Use nitrogen or oil-free compressed air for gaseous-burst systems at a frequency of 6 bursts per minute with a 2-second duration. If you use air, be sure to turn it off when you are not processing film so that the fixer does not become oxidized.

Final Rinse/Stabilizer—Agitation by solution turbulation is *optional.* **Do not** use gaseous-burst agitation for stabilizer or final rinse; the solution will foam severely.

Filtration

Processing solutions and wash water may contain some insoluble materials. If you don't filter out these materials, they can build up on film, tank walls, rollers, and lines, and can damage film. Generally, filters with a porosity of 10 to 30 microns are effective for solutions and wash water, and filters with a porosity of 15 microns are effective for incoming water supplies.

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

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

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

Replenishment Rates

The replenishment rates in Tables 2-2, 2-3, and 2-4 are given for the most commonly used unit for the type of processor listed.

- Table 2-2 rates are in millilitres per linear foot and linear metre of film.
- Table 2-3 rates are in millilitres per square foot or metre of film.
- Table 2-4 rates are in millilitres per roll or sheet of film.

Starting Replenishment Rate—The developer replenishment rates given in the tables are starting-point recommendations; they are subject to change depending on the mix of film types processed and other variables of the processing system. Replenishment rates depend on the film type, the amount of exposure, and the presence/absence of sprocket holes.

You can use a single rate for processing all films by determining an average rate that reflects the relative percentages of the different films and sizes that you process. Verify this mix often to be sure that it hasn't changed.

An average starting replenishment rate for FLEXICOLOR Developer Replenisher LORR in a finishing lab that processes a typical mix of 135 Kodak color negative films and ADVANTIX Film* is 5.4 mL/ft (17.7 mL/m).

Carryover—The replenishment rates for secondary solutions must balance the carryover rate of the preceding solution to maintain chemical concentrations and pH level. If carryover is excessive and you do not increase the replenishment rate to compensate, problems such as retained silver and leuco-cyan dye can occur. For rack-and-tank processors, the bleach, fixer, and stabilizer/final rinse replenishment rates reflect the higher carryover rates typical for this type of processor. Typical carryover rates are as follows:

Continuous and Roller-Transport Processors (with efficient squeegees)	
Film Type	**Carryover Rate**
110, 126, 135, 35 mm, and 46 mm film sizes	10 mL/ft^2 (107.5 mL/m^2)
Other roll- and sheet-film sizes	12 mL/ft^2 (129 mL/m^2)

Rack-and-Tank Processors	
Film Type	**Carryover Rate**
110, 126, 135 film sizes	14 mL/ft^2 (150 mL/m^2)
Other roll- and sheet-film sizes	16 mL/ft^2 (172 mL/m^2)

Wash Rates—The wash rates given in Tables 2-2, 2-3, and 2-4 are for the first wash and for a two-stage countercurrent final wash. If the final wash is a single stage, use twice the rate given in the table. If your processor does not meter water for the unit area of film (see Table 2-5), adjust the wash-water rate for the maximum film load you process, and then operate at this rate. Do not use average rates. For the first wash, you can use the overflow from the second wash instead of fresh water.

* In the U.S., this mix is approximately 40 percent KODAK GOLD 100 and 200 Films; 46 percent KODAK MAX 400 and MAX ZOOM 800 Film; 14 percent KODAK ADVANTIX Films, and 6 percent all other Kodak color negative films.

Table 2-2

Replenishment and Wash Rates for Continuous and Roller-Transport Processors, mL/ft (mL/m)*				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III & Bleach III HV,† Fixer,†‡ Stabilizer, and Final Rinse Replenishers†**	**Wash Water§**
ADVANTIX Bright Sun & Flash				
24 mm	2.9 (9.5)	5.8 (19.0)	6.3 (20.7)	230 (750)
ADVANTIX Versatility, **ADVANTIX Black & White 400**				
24 mm	3.4 (11.2)	6.8 (22.4)	6.3 (20.7)	230 (750)
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
135	5.0 (16.4)	10.0 (32.8)	9.2 (30)	330 (1080)
120/220	9.5 (31.2)	19.0 (62.3)	19.2 (62)	580 (1900)
35 mm perf	5.5 (18.0)	11.0 (36)	9.2 (30)	330 (1080)
35 mm unperf	7.4 (24.3)	14.8 (48.6)	9.2 (30)	330 (1080)
46 mm unperf	7.1 (23.3)	14.2 (46.6)	12.0 (39)	430 (1400)
70 mm perf	10.4 (34.1)	20.8 (68.2)	22.0 (72)	650 (2130)
70 mm unperf	10.8 (35.5)	21.6 (71.0)	22.0 (72)	650 (2130)
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide Film				
135	6.3 (20.7)	12.5 (41.0)	9.2 (30)	330 (1080)
110	5.3 (17.4)	10.6 (34.8)	4.2 (14)	150 (490)
126	9.4 (30.8)	18.8 (61.6)	9.2 (30)	330 (1080)
120/220	14.2 (46.6)	28.3 (92.8)	19.0 (62)	580 (1900)
35 mm perf	6.9 (22.6)	13.7 (44.9)	9.2 (30)	330 (1080)
35 mm unperf	9.3 (30.5)	18.5 (60.7)	9.2 (30)	330 (1080)
46 mm unperf	11.3 (37.1)	22.6 (74.1)	12.0 (39)	430 (1400)
70 mm perf	14.4 (47.2)	28.8 (94.5)	22.0 (72)	650 (2130)
70 mm unperf	16.9 (55.4)	33.8 (110.1)	22.0 (72)	650 (2130)

* To convert the rates to millilitres per minute, multiply the linear rate (millilitres per foot or metre) by the processor speed (feet or metres per minute).
† Assumes the use of efficient squeegees.
‡ For ELECTROSILVER Fixer Replenisher LORR, multiply the rate given for FLEXICOLOR Fixer and Replenisher by 0.31.
§ Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-3

Replenishment and Wash Rates for Roller-Transport Processors, mL/ft² (mL/m²)				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III and Bleach III HV, Fixer, Stabilizer, and Final Rinse Replenishers**	**Wash Water***
ADVANTIX Bright Sun & Flash, ADVANTIX Versatility, ADVANTIX Black & White 400				
24 mm	41 (441)	82 (883)	80 (861)	2900 (31000)
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
35 mm	47 (506)	94 (1012)	80 (861)	2900 (31000)
120/220	47 (506)	94 (1012)	95 (1023)	2900 (31000)
Sheet	58 (622)	116 (1245)	107 (1152)	5500 (59000)
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film				
35 mm/46 mm	65 (700)	130 (1400)	80 (861)	2900 (31000)
110, 126	91 (980)	182 (1960)	80 (861)	2900 (31000)
120/220, 70 mm	65 (700)	130 (1400)	95 (1023)	2900 (31000)
Sheet	82 (861)	160 (1722)	107 (1152)	5500 (59000)

* Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-4

Replenishment and Wash Rates for Rack-and-Tank Processors, mL per roll or sheet*				
KODAK Film/ Film Size	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Bleach III and Bleach III HV, Fixer,† Stabilizer, and Final Rinse Replenishers**	**Wash Water‡**
ADVANTIX Bright Sun & Flash				
24 mm x 15 exp	6.7	13.4	24.0	1180
24 mm x 25 exp	10.3	20.6	34.0	1670
24 mm x 40 exp	15.5	31.0	48.6	2390
ADVANTIX Versatility, ADVANTIX Black & White 400				
24 mm x 15 exp	7.9	15.8	24.0	1180
24 mm x 25 exp	12.2	24.4	34.0	1670
24 mm x 40 exp	18.5	37.0	48.6	2390
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T				
135-12	9.6	19.3	29.0	1600
135-24	17.8	35.6	48.0	2500
135-36	26.1	52.1	66.0	3500
120	25.4	50.8	66.0	3100
220	51.2	102.4	130.0	6200
4 x 5 inches	8.2	16.4	17.0	1600
8 x 10 inches	32.8	65.6	67	6400
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film				
135-12	12.2	24.4	29.0	1600
135-24	22.7	45.3	48.0	2500
135-36	33.1	66.1	66.0	3500
110-24	14.1	28.1	14.0	740
126-24	24.8	49.6	34.0	1800
120	37.8	75.5	66.0	3100
220	75.5	151.0	130.0	6200
4 x 5 inches	11.2	22.4	17.0	1600
8 x 10 inches	44.8	89.6	67.0	6400

* To convert the rates to millilitres per rack, add the rate for each roll on the rack.
† For ELECTROSILVER Fixer Replenisher LORR, multiply the rate given for FLEXICOLOR Fixer and Replenisher by 0.31.
‡ Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

Table 2-5 Film Areas

Roll-Film Size	Area per Roll ft² (m²)
135-12 (full roll)	0.255 (0.0237)
135-12 (minus tongue)*	0.248 (0.0230)†
135-24 (full roll)	0.427(0.0397)
135-24 (minus tongue)*	0.420 (0.0391)†
135-36 (full roll)	0.599 (0.0557)
135-36 (minus tongue)*	0.592 (0.0551)†
1 ft 135	0.115 (0.0100)†
120	0.543 (0.0504)
220	1.094 (0.1020)
1 ft 120/220	0.2025 (0.0188)
110-12	0.078 (0.0073)
110-24	0.131 (0.0122)
1 ft 110	0.0525 (0.0049)
24 mm x 15 exp	0.2004 (0.0186)
24 mm x 25 exp	0.2823 (0.0262)
24 mm x 40 exp	0.4049 (0.0376)
1 ft 24 mm	0.0787 (0.0073)
1 ft 126	0.114 (0.0106)
1 ft 46 mm	0.151 (0.0140)
1 ft 70 mm	0.230 (0.0214)

* Tongue removed between perforations 10 and 11.
† To adjust for sprocket holes, reduce the area by 6.66 percent.

Sheet-Film Size (Inches)	Area per Sheet ft² (m²)
2 1/4 x 3 1/4	0.0508 (0.0047)
3 1/4 x 4 1/4	0.0959 (0.0089)
4 x 5	0.139 (0.0129)
5 x 7	0.243 (0.0226)
8 x 10	0.556 (0.0516)
11 x 14	1.070 (0.0990)

Calculating Replenishment Rates for Rack-and-Tank Processors

To calculate replenishment rates for rack-and-tank processors, follow this procedure:

1. Keep a record of the number of rolls of each size you process and the number of racks used for a period of time, such as a week or a month. Include all racks—even those that are only partially filled.
2. Multiply the total number of rolls of each size by the replenishment rate in millilitres per roll for that size (see Table 2-4.) This will give you the total replenisher volume needed for each roll size.
3. Add the replenisher volumes for all film sizes determined in step 2. This gives you the total replenisher volume used for *all* sizes. Divide this volume by the number of racks used (from step 1) to obtain the average replenishment rate per rack. Film populations and process conditions can change; check your film population and these calculated rates often. Monitor these rates with your control-strip plots.
4. To calculate wash rates, add the wash-water volume for all film sizes. Divide this total volume by the number of minutes the film is in the wash (for all wash tanks). This will give you mL/min. Convert to litres per minute or gallons per minute.

EXAMPLE:

During one week, a lab processes 483 rolls using 125 racks. To calculate the average rate per rack for FLEXICOLOR Developer Replenisher, they follow the steps above. First they record the number of rolls of film of each type and size that they process. Then they multiply the total number of rolls of each type and size processed that week by the corresponding replenishment rate from Table 2-4 to obtain the total volume for that film type and size. Then they calculate total volume of replenisher used by totalling the amounts for all film sizes. By dividing that amount by the number or racks used that week, they obtain the average replenishment rate per rack. They use the same method to calculate the rate per rack for the other solutions.

The calculation for the developer replenishment rate is shown in Table 2-6.

Table 2-6 Replenishment-Rate Calculation

Film Type	Size	Number of Rolls	Replenishment Rate mL/roll	Total Replenisher Volume mL
PROFESSIONAL PORTRA 160NC/VC	220	124	102.4	12,698
PROFESSIONAL PORTRA 400NC/VC/UC	220	202	151	30,502
PROFESSIONAL PORTRA 400NC/VC/UC	135-36	49	66.1	3,239
PROFESSIONAL PORTRA 160NC/VC	120	34	50.8	1,727
PROFESSIONAL PORTRA 400NC/VC/UC	120	50	75.5	3,775
PROFESSIONAL PORTRA 800	135-36	24	66.1	1586
			TOTAL	53,527

Total Number of Racks Used = 125

Average Developer Replenishment Rate per rack = 53,527/125 = 428 mL/rack

Push-Processing KODAK PROFESSIONAL PORTRA Films

KODAK PROFESSIONAL PORTRA 400UC and PORTRA 800 Films are designed so that you can push-process them to higher exposure indexes. You can push-process PORTRA 400UC Film to an exposure index of 800, and PORTRA 800 Film to exposure indexes of 1600 and 3200, and produce negatives that yield good-quality prints.

To push-process these films, extend the developer time according to Table 2-7. Keep all other process times the same as those for a normal process.

Table 2-7 Developer Time for Push Processing

Exposure Index	Developer Time (min:sec)
PROFESSIONAL PORTRA 400UC Film	
EI 400	3:15
EI 800 (Push 1)	3:45
PROFESSIONAL PORTRA 800 Film	
EI 800	3:15
EI 1600 (Push 1)	3:45
EI 3200 (Push 2)	4:15

PROCESSING OPTIONS

You may be able to use two processing options that will reduce chemical discharge and may reduce chemical costs. These options are bleach regeneration and closed-loop fixer desilvering. Bleach regeneration reduces chemical costs and requires only a modest capital expenditure and/or processor modification.

If you need assistance in determining if these options are suitable for your processing laboratory, contact your Kodak field representative. If your lab has other needs not covered in this manual, your Kodak field representative may also be able to help.

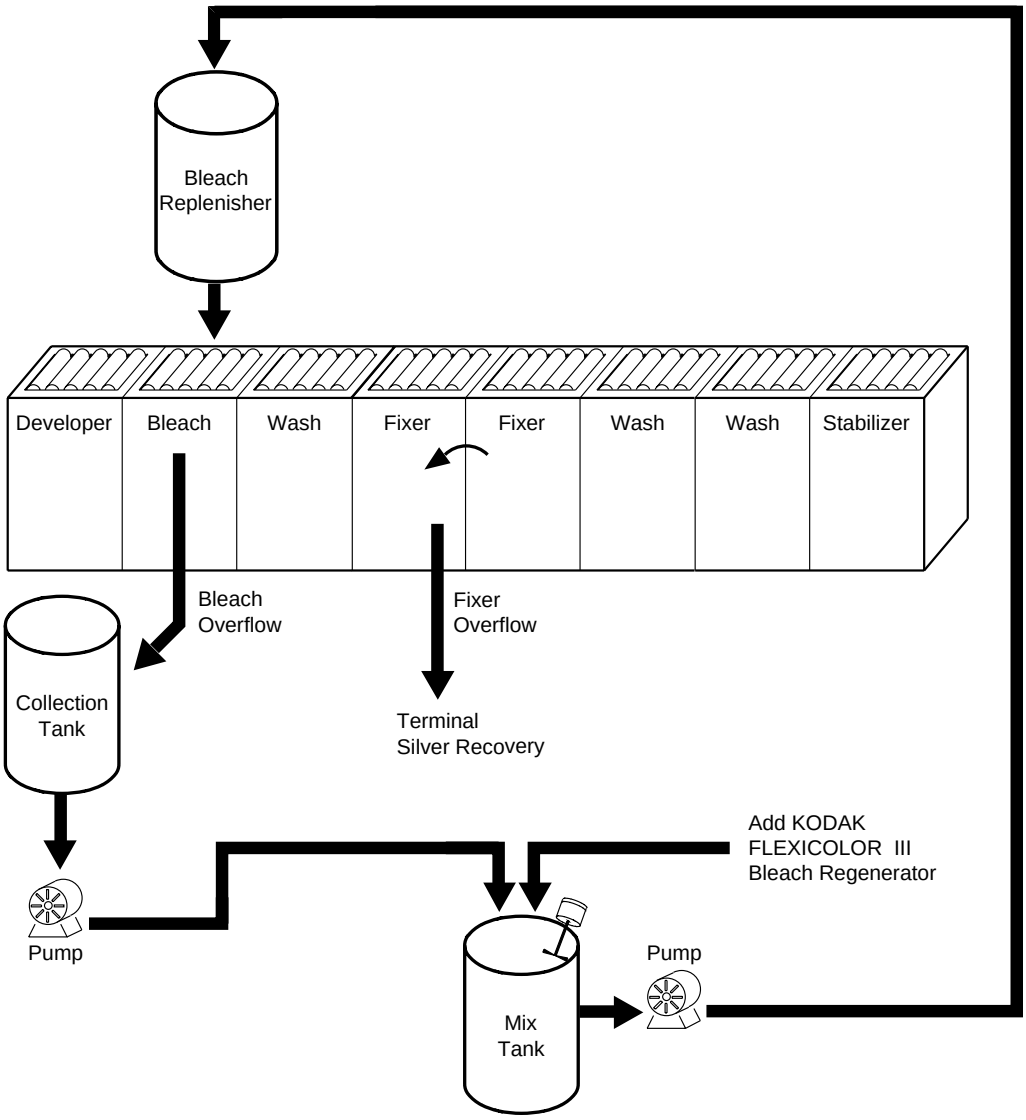
Regenerating KODAK FLEXICOLOR Bleach III

It is easy to regenerate your Process C-41 bleach overflow to useable bleach replenisher. Regenerating your bleach overflow can significantly reduce chemical costs, and reduce the amount of iron, ammonia, and COD in the overall effluent. To regenerate your bleach, simply collect the overflow from the bleach working tank of the processor, then add FLEXICOLOR Bleach III Regenerator or FLEXICOLOR Bleach III HV Regenerator as per directions. Use FLEXICOLOR Bleach III Regenerator to regenerate bleach overflow from a rack-and-tank, roller transport, or low- to mid-volume continuous processor. Use FLEXICOLOR Bleach III HV Regenerator to regenerate the bleach overflow only from a high-volume continuous processor, such as a cine processor that processes 3,000 or more rolls of film a day.

Use the same processing steps and conditions as those listed in Table 2-1. Once the bleach overflow is regenerated, use it as replenisher at the same rates given in Tables 2-2, 2-3, and 2-4.

As with normal bleach replenishment, it is very important to check the replenishment rate, check that bleach aeration is sufficient, and minimize developer carryover into the bleach. Too much developer carryover can dilute the bleach and raise the pH, which reduces bleach activity. In continuous processors, keep the squeegees well maintained to minimize developer carryover. You can check the concentration of regenerated bleach by measuring its specific gravity (see *Check Your Mixes with Specific-Gravity Measurements* in Section 1). Specific gravity specifications for FLEXICOLOR Bleach III and FLEXICOLOR Bleach III HV are listed in Table 1-5.

Figure 2-1



Option 1

F002_0200DC

Desilvering Fixer in a Closed-Loop System with KODAK ELECTROSILVER Fixer and Replenisher LORR

KODAK ELECTROSILVER Fixer and Replenisher LORR is specially designed for systems that electrolytically desilver fixer in a closed-loop system. By using this type of system with ELECTROSILVER Fixer and Replenisher LORR, you can reduce the fixer replenishment rate by over 60 percent and reduce the BOD, ammonia, and sulfates in your overall processing effluent. Sulfite analysis and pH measurements are not needed when you desilver and replenish ELECTROSILVER Fixer and Replenisher LORR according to directions.

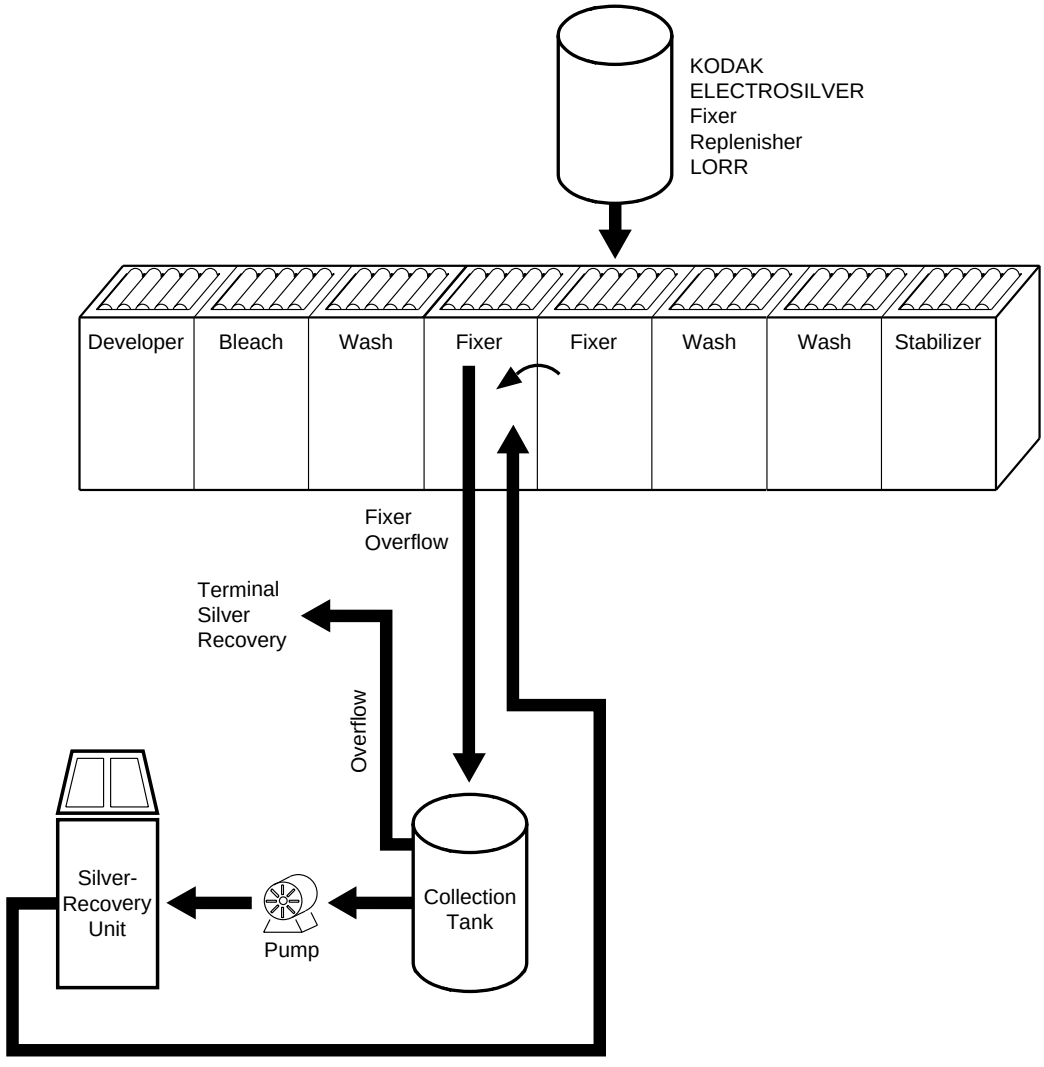
Use the same processing steps and conditions as those listed in Table 2-1. To determine a replenishment rate, multiply the rate given for FLEXICOLOR Fixer in Table 2-2, 2-3, or 2-4, by 0.31.

The silver concentration of the *first* fixer tank solution must be maintained at 0.5 to 1.2 grams per litre. If you desilver to lower concentrations, silver sulfide may form, resulting in poor plating on the drum of the electrolytic cell. Silver sulfide may also carry back into the fixer and wash, causing dirt in the fixer and on the film. Monitor the silver concentration of the first fixer tank solution regularly, and *do not* reduce the silver below 0.5 g/L.

Silver concentrations that are too high affect fixer efficiency and can also result in a loss of silver when excess silver is carried into the wash.

Note: The recirculation rate of a closed-loop system should be equivalent in volume to 3.5 to 5 turnovers of the first fixer tank per hour.

Figure 2-2



Option 2

F002_0201DC

BLEACH AERATION IN PROCESS C-41

Proper aeration of the bleach tank solution serves three purposes:

1. It oxidizes the bleach solution completely. (Inadequate oxidation leads to an increase in ferrous iron concentration and eventually to leuco-cyan-dye formation in some films and/or retained silver.)
2. In rack-and-tank processors, it agitates the solution for uniform stopping and bleaching action.
3. It completely oxidizes developer carryover in the bleach tank.

To provide complete oxidation of ferrous iron, the aeration rate for the bleach should be directly proportional to the film load entering the tank solution. As a general guideline for aeration, use Figure 2-3, a graph of approximate aeration rates for continuous processors. We have also listed some general guidelines for rack-and-tank processors.

Figure 2-3 shows that the aeration rate for continuous processors varies with film load. You can easily calculate film load (square feet of film per minute) by multiplying the machine speed (ft/min) by the area of the film per length (ft^2/ft). See Table 2-5. In most cases, it is best to adjust aeration rates to handle the maximum film load and then operate at this rate without any further adjustment.

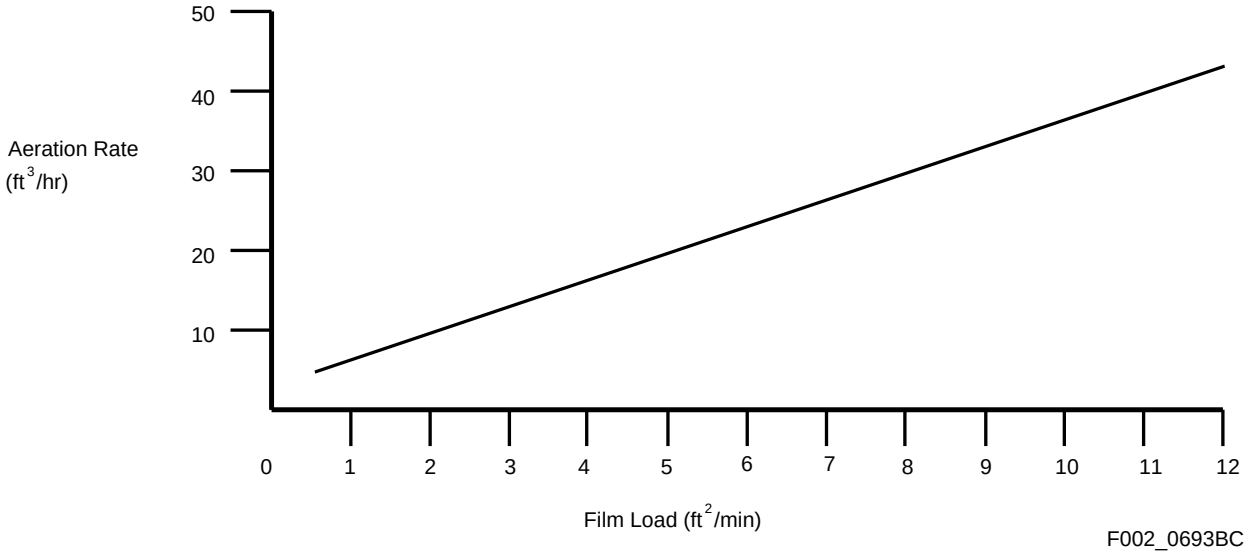
The aeration rates for rack-and-tank machines in Table 2-8 are in terms of bursts of oil-free air per minute. This starting-point rate should handle the maximum film load in most rack-and-tank processors.

Table 2-8

Bleach Aeration Rate for Rack-And-Tank Processors (Oil-Free Air)	
Air Flow Rate	Six bursts per minute, each lasting for a duration of 2 seconds
Distributor Bar	$^3/_{16}$ inch ID
Hole Diameter	0.65 mm (0.026 in.)
Tank Width	13 inches
Tank Depth	3 feet
Hole Spacing	Variable (to achieve uniform bubbling at solution surface): 10 holes averaging 1.12 inches apart on each side of bar

Bleach Aeration Rate for Continuous Processors (Oil-Free Air)	
Distributor Bar	$^5/_8$ inch ID
Hole Diameter	0.75 mm (0.030 in.)
Tank Width	16 inches
Tank Depth	3 feet
Hole Spacing	13 holes 1 inch apart on top of bar

Figure 2-3 Bleach Aeration Rate for Continuous Processors



The information in the aeration-rate graph is valid *only* for the conditions specified, i.e., at specific distributor-hole diameters and hole spacing. In general, the required aeration rate decreases with decreasing bubble size or increases with increasing bubble size. The number and spacing of holes in distributor bars should provide adequate agitation of the tank solution. Also consider the following:

- Decreasing the hole diameter or the hole spacing for bubbles does not always decrease the required aeration rate. If bubbles become small enough or are too close together, they tend to coalesce and form larger bubbles, decreasing efficiency. Also, very small bubbles often create a fine mist on the top of the solution, which increases the risk of bleach contamination of the developer.
- To minimize the risk of bleach contamination of the developer, use the white-paper test to determine if a problem exists. The white-paper test is a simple but effective method for measuring spattering of solution. Place a sheet of white paper between the developer and the bleach tank at the top of the tank wall. If, after an hour of operation with normal aeration and recirculation, you detect bleach deposits on the paper, bleach agitation is excessive. Find an alternate method of aeration or cover the bleach tank.
- Maintain uniform agitation throughout the tank by placing distributor bars or spargers to provide adequate bubbling over the entire solution surface. Holes in distributor bars for continuous processors should be uniformly spaced and not more than 2.5 cm (1 in.) apart. Rack-and-tank processors, however, may require variable hole spacing to compensate for pressure differences and provide uniform agitation from air bursts. The length of distributor bars will vary with tank size, but in general, the bar should extend approximately the entire width of the tank. Consider decreasing the hole spacing or using additional distributor bars in tanks where agitation is inadequate.

In many processors, the bleach is aerated by a venturi effect (aspirator) of the recirculation pump. Inspect for the following when you use this method:

1. Be sure foam is minimal.
2. Use the white-paper test to ensure that no bleach is foaming back or misting into the developer.
3. Check for tar (rapidly oxidized color developing agent) in foam. Opening the aspirator too much may produce severe tar along with foam. When this occurs, close the aspirator to reduce foam.

3 SINK-LINE, BATCH, AND ROTARY-TUBE PROCESSORS

This section gives the steps and conditions for using KODAK FLEXICOLOR Chemicals to process Kodak color negative films in sink-line, batch, and rotary-tube processes with Process C-41.

USING SINK-LINE PROCESSORS

Equipment

The basic equipment that you'll need for this type of processing includes the following:

Sink—To maintain a solution processing temperature of 37.8°C (100°F), use a tempered-water bath for the processing tanks. You can use a deep sink with a standpipe of sufficient length to surround the tank to solution level with tempered water.

Processing Tank—Tanks made of stainless steel provide the best heat transfer for solution temperature control. You can also use tanks such as KODAK Hard Rubber Tanks or tanks supplied with the processing line.

Processing Reels—Use commercially available wire or plastic reels. Be sure that the reels fit the reel holders properly.

Reel Holders—Use reel holders such as the KODAK Processing Rack. Sizes are not standard; be sure that the reel holders and processing tanks are compatible.

Sheet-Film Hangers and Separators—Typical equipment should include film hangers for the sheet-film sizes that you process. During processing, use separators to provide a space of approximately 13 mm ($^1/_2$ in.) between hangers.

Gaseous-Burst Agitation Equipment—Use a gas valve that you can adjust to vary the length of the burst and the interval between bursts, and a gas distributor that provides uniform gas distribution. For the developer, use only compressed nitrogen gas that has a purity of 99 percent (or higher).

Steps and Conditions

The processing steps and conditions for Process C-41 in sink-line processors are similar to those for other types of processors. However, with sink-line processing, most of the operation, such as agitation, transferring the film between solutions, temperature control, and replenishment, are done manually.

Table 3-1 Steps and Conditions—Sink-Line Processors

Solution/Step	Time* min:sec	Temperature °C (°F)	Comment
FLEXICOLOR Developer	3:15	37.8 ±0.15 (100.0 ±0.25)†	Agitate with nitrogen and/or manual agitation.
FLEXICOLOR Bleach III‡	6:30	24 to 41 (75 to 105)	Agitate and aerate with oil-free air and/ or manual agitation.
Wash	3:15	24 to 41 (75 to 105)	Agitate with oil-free air or nitrogen or manual agitation.
FLEXICOLOR Fixer and Replenisher	6:30	24 to 41 (75 to 105)	Agitate with oil-free air or nitrogen or manual agitation.
Wash	3:15	24 to 41 (75 to 105)	Agitate with oil-free air or nitrogen or manual agitation.
FLEXICOLOR Stabilizer III	1:30	24 to 41 (75 to 105)	Manual agitation only.
Dry	As needed	24 to 43 (75 to 110)	Remove roll film from reel.

* Times include a 10-second drain time at the end of each step.

† The developer temperature given is the recommended temperature *during development;* it is *not* the recommended starting temperature for the developer (see *Developer Starting Temperature*).

‡ You can turn on the lights after the bleach step.

Temperature Control

A temperature-control valve on the water supply for the tempered-water bath will help you maintain solution temperature. Tanks made of stainless steel provide the best heat transfer.

Developer Starting Temperature—The developer temperature given in Table 3-1 is the recommended temperature during development. (It is not the recommended starting temperature for the developer.)

To determine the starting temperature of the developer, follow this procedure:

1. Measure and record the room temperature near the developer tank.
2. Adjust the developer temperature to 37.8°C (100.0°F). Use an unshielded thermometer with an expanded range calibrated in 0.1°C units, such as the ASTM No. 91C, or Fahrenheit equivalent. Put the thermometer in the developer for several minutes until it registers an equilibrium temperature. Record the temperature and replace the thermometer in the developer.
3. Lower a full rack of processed scrap film similar to what you normally process into the developer. Provide the same initial agitation that you normally use in processing. After 60 seconds (measured from the time when you first placed the film in the developer), record the solution temperature.
4. Calculate the difference in the developer temperature between steps 2 and 3.
5. Add the temperature difference you calculated in step 4 to the recommended temperature of 37.8°C (100°F) to obtain the *starting temperature.* As long as the processing conditions (room temperature and amount and type of film) remain the same, you can use this as the starting temperature for subsequent processes. If the processing conditions change, repeat this procedure for the new conditions.

Example: If the temperature change for a metal carrier filled with thirteen 8 x 10-inch sheets of film (on hangers) is 0.6°C (1.1°F) at a room temperature of 21°C (70°F), your actual starting developer temperature for this room temperature and amount of film should be

37.8° (100.0) + 0.6°C (1.1°F) = 38.4°C (101.1°F)

Although the temperature difference appears small, the effect will be significant, particularly if you are critical about your processing results and want to maintain consistency between processes.

Agitation

Although you can use manual or gaseous-burst agitation for sink-line processing, using a combination of both types will give the best uniformity, particularly for sheet films.

Unless you find the results satisfactory for your needs, do not use nitrogen-burst or manual agitation alone. Using only nitrogen-burst agitation in the developer may result in nonuniformity. The amount of nonuniformity may be affected by the distribution of the burst, burst frequency, and bubble size, as well as factors such as reel or hanger design and location of the reel or hanger in the tank.

Use only nitrogen for gaseous-burst agitation in the developer, because air will oxidize the developer. However, using air for agitation in the bleach is necessary to oxidize the exhausted bleach to a usable form, and to oxidize developer carried into the bleach. Without aeration, the bleach loses activity. If you cannot use air agitation in the bleach, you must use another method to aerate it.

In the fixer and washes, you can use either compressed air or nitrogen.

Combination of Manual and Gaseous-Burst Agitation—This is the recommended method of agitation for sink-line processing.

Developer—

1. When you first immerse the film in the developer, provide a continuous nitrogen burst for the first 15 seconds.
2. After the initial burst, provide a 2-second burst every 28 seconds.
3. At the end of each nitrogen burst, manually agitate for 13 seconds by lifting the rack from the developer, and tilting it toward the *front* of the tank. Tap the rack against the top edge of the tank and then reimmerse the rack. Then repeat this procedure, but after lifting the rack, tilt it toward the *back* of the tank. End this sequence by tapping the rack against the top edge of the tank and then reimmersing the rack.
4. Steps 2 and 3 make up a single 15-second agitation sequence. Repeat this sequence throughout development.

Bleach, First Wash, and Fixer—Use the same agitation procedure as you did for the developer, but use air instead of nitrogen for the gaseous-burst agitation in the bleach.

Final Wash—Use *only* gaseous-burst agitation (compressed air or nitrogen), with a 2-second burst every 28 seconds.

Stabilizer—**Do not** use gaseous-burst agitation. Provide continuous manual agitation for the first 15 seconds only. Use no other agitation during the rest of the step.

Manual Agitation—Use this type of agitation alone *only* if it provides satisfactory uniformity:

Developer—

1. Immerse the rack fully into the developer. Rapidly tap it on the bottom of the tank to dislodge any air bubbles. Raise the rack until the bottom is out of the developer; then reimmerse it. Do this once. This requires 4 to 5 seconds.
2. After the initial agitation, let the rack sit for 10 seconds. Then lift it straight up until the bottom is just out of the developer solution. Reimmerse it without draining. Do this with an even, uniform motion, taking 2 to 3 seconds to complete it. Repeat this procedure once every 10 seconds (6 times per minute).
3. Ten seconds before the end of the development time, raise the rack, tilt it about 30 degrees toward one corner, and drain it for 10 seconds. Then move the rack into the bleach.

This agitation procedure should produce satisfactory process control. However, if the contrast plots are slightly low, increase the frequency of agitation. If the plots are slightly high, reduce the frequency of agitation, but do not reduce the frequency to less than twice per minute.

Other Solutions—

1. Use the same *initial* agitation as you used for the developer.
2. Use four lifting cycles per minute at 15-second intervals. You may need to provide aeration for the bleach (see *Bleach Aeration*).

Washes—With a running-water wash, use the same *initial* agitation that you used for the developer. No other agitation is needed.

Gaseous-Burst Agitation—Use this type of agitation alone *only* if it provides satisfactory uniformity. Use only nitrogen in the developer.

Developer—

1. Immerse the rack fully into the developer. Rapidly tap it on the bottom of the tank to dislodge any air bubbles. Raise the rack until the bottom is out of the developer; then reimmerse it. Do this once. This requires 4 to 5 seconds.
2. Eight seconds after immersing the film, give a 2-second nitrogen burst. Repeat the 2-second burst at 10-second intervals (6 times per minute). If necessary, increase the frequency of the 2-second burst to 10 times per minute or decrease it to twice per minute to adjust the contrast (HD – LD values in the control plot).

Other Solutions—

1. Immerse the rack fully into the solution. Rapidly tap it on the bottom of the tank to dislodge any air bubbles. Raise the rack until the bottom is out of the solution; then reimmerse it. Do this once. This requires 4 to 5 seconds.
2. After the initial agitation, provide a 2-second burst 4 times per minute. You *must* use air for bleach agitation. You can use air or nitrogen in the fixer.

Bleach Aeration

For efficient bleaching, you must aerate the bleach. Continuous gaseous-burst agitation in the bleach throughout the entire process cycle will provide the necessary aeration.

If you use manual agitation for your process, you must provide some other means of mixing air into the bleach. One way to do this is to bubble air from a compressed-air supply into the bleach through a sparger or by using an aquarium pump for about 5 minutes during each process. Use a valve pressure of about 2.5 lb/in^2 (17 kPa). You can also draw air into the bleach by vigorously stirring it with a mixer.

Replenishment Rates

Replenishment helps maintain the solutions at normal strength. Replenishment compensates for—

- carry-in from the preceding solution
- chemicals that dissolve out of the film during processing
- depletion of chemicals that occurs during chemical reactions

Table 3-2 gives starting-point replenishment rates for individual rolls, sheets, and film holders. Base your replenishment rates on the amount and type of film you process.

Table 3-2

Replenishment Rates—Sink-Line Processing*			
KODAK Film and Film Size	**FLEXICOLOR Developer Replenisher**	**FLEXICOLOR Developer Replenisher LORR**	**FLEXICOLOR Bleach III, Fixer, Stabilizer III Replenishers**
	mL/roll or sheet		
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T			
135-12	19.3	9.6	37
135-24	35.6	17.8	52
135-36	52.1	26.1	69
120	50.0	25.4	72
220	102.4	51.2	144
4 x 5 inches	16.4	8.2	28
8 x 10 inches	65.6	32.8	87
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film			
110-24	28.2	14.1	11
135-12	24.4	12.2	37
135-24	45.4	22.7	52
135-36	66.2	33.1	69
120	75.5	37.8	72
220	151.0	75.5	144
4 x 5 inches	22.4	11.2	28
8 x 10 inches	89.6	44.8	87
Reels or Holders Without Film			
Reel carrier	0	0	30
Sheet-film carrier	0	0	50
135-12/20	0	0	15
135-24/36	0	0	23
110-12/24	0	0	10
120	0	0	20
70 mm	0	0	25
4 x 5 inches (4 sheets)	0	0	15
5 x 7 inches (2 sheets)	0	0	10
8 x 10 inches	0	0	10

* Replenishment rates for film include the reel or sheet-film hanger. If empty reels or hangers are run through the process, include rates for reels or sheet-film hangers. The rates are for metal reels; plastic reels have a higher carryover rate and require an increase in bleach, fixer, and stabilizer replenishment rates of approximately 60 percent for 110-size reels and 25 percent for 135- and 120-size reels. For wash water, use a flow rate of 2 gallons per minute.

Capacity of Unreplenished Solutions

Instead of replenishing the solutions, you can use them until they are exhausted and then discard them. Table 3-3 shows you the number of rolls you can process before you must replace the developer. The developer capacity is the same for FLEXICOLOR Developer or a working solution made from FLEXICOLOR Developer LORR.

Table 3-3 Capacity of Unreplenished Solutions—Batch Processing

KODAK Film and Film Size	Developer Capacity* (rolls/sheets) per	
	1 gallon	1 litre
Bright Sun, Bright Sun & Flash, ROYAL GOLD 200, PROFESSIONAL PORTRA 160NC/VC, PROFESSIONAL PORTRA 100T		
135-12	48	12
135-24	22	5
135-36	15	4
110-24	32	8
120	11	3
220	5	1
4 x 5 inches	38	10
8 x 10 inches	10	3
MAX Versatility, MAX Versatility Plus, ROYAL GOLD 400, Black & White Film, GOLD (110), PROFESSIONAL PORTRA 400NC/VC/UC, PROFESSIONAL PORTRA 400BW, PROFESSIONAL PORTRA 800, PROFESSIONAL T400 CN, Commercial Internegative, VERICOLOR Slide and Print Film		
135-12	42	11
135-24	20	5
135-36	14	3
120	9	2
220	4	1
4 x 5 inches	33	8
8 x 10 inches	8	2

* The capacity for the other solutions (bleach, fixer, and stabilizer) is twice the number of rolls or sheets given for the developer.

Drying

Remove roll film from reels before drying. Hang film in a dust-free place with adequate air circulation. If you use a drying cabinet, be sure that the forced air is filtered, and do not let the temperature exceed 43°C (110°F). If curl is excessive, ambient conditions are probably too dry; increase the relative humidity.

Push-Processing KODAK PROFESSIONAL PORTRA Films in Sink-Line Processors

KODAK PROFESSIONAL PORTRA 400UC and PORTRA 800 Films are designed so that you can push-process them to higher exposure indexes. You can push-process PORTRA 400UC Film to an exposure index of 800, and PORTRA 800 film to exposure indexes of 1600 and 3200, and produce negatives that yield good-quality prints.

To push-process these films, extend the development time for the exposure index you used according to the table below. Keep the times for all other solutions the same as those for a normal process.

KODAK Film	Exposed at (EI)	Development Time (min:sec)
PROFESSIONAL PORTRA 400UC	400 800	3:15 3:45
PROFESSIONAL PORTRA 800	800 1600 3200	3:15 3:45 4:15

USING ROTARY-TUBE PROCESSORS

Steps and Conditions

Rotary-tube processors are another popular type of batch processor. You can use these processors for a variety of film sizes (rolls to large sheets) with good results. They also use a fairly small volume of chemicals, which are discarded after a single use. For Process C-41 chemicals suitable for use with rotary-tube and drum processors, see Section 1, *KODAK FLEXICOLOR Chemicals.*

Although all chemicals used in a rotary-tube processor are discarded after a single use, you can capture the used bleach solution and reuse it up to its capacity before discarding it. Use Table 3-3 to calculate how many films you can process before the bleach is exhausted. **Do not attempt to replenish or regenerate used bleach solution. Reuse it only to the batch capacity; then discard it. Also, do not reuse developer, fixer, or stabilizer. You must discard these solutions after a single use.**

Except for some additional steps required to maintain the correct processing temperature, the steps and conditions for most rotary-tube processors are similar to those for other types of processors. Although the results from batch-type systems may not be as consistent as those from replenished systems, they can be very satisfactory if you follow the manufacturer's recommendations for your processor and the processing recommendations in Tables 3-4 and 3-5. For information on monitoring your process, see Section 5, *Process Monitoring and Troubleshooting*.

Table 3-4 Steps and Conditions—Rotary-Tube Processors, Process C-41

Solution/Step	Time* (min:sec)	Temperature °C (°F)
Optional Warm-Up† tempered water bath or hot air	2:00 to 6:00	38 to 45 (100.4 to 113)
FLEXICOLOR Developer	3:15‡	37.8 ±0.15 (100.0 ±0.25)
FLEXICOLOR Bleach III	6:30	24 to 38 (75 to 100)
FLEXICOLOR Fixer	6:30	24 to 38 (75 to 100)
Wash	3:00	24 to 38 (75 to 100)
FLEXICOLOR Stabilizer III§	1:30	24 to 38 (75 to 100)
Dry	As needed	20 to 60 (68 to 140)

* Times include a 10-second drain time at the end of each step. Solution volume depends on the type of processor.

† Tube is loaded with film and ready for processing. Determine the best time by calibrating the tube. See *Process Control and Adjustment*. **Do not immerse the film in a warm water pre-soak. Warm-up step is done by warming the outside of the tube with hot air or in a tempered water bath**.

‡ Determine the correct time for your processor by running a test with your tube. See *Process Control and Adjustment*.

§ If stabilizer foaming in the tube is a problem, you can stabilize the film in a separate tank.

Table 3-5 Steps and Conditions—Rotary-Tube Processors, Process C-41RA

Solution/Step	Time* (min:sec)	Temperature °C (°F)
Optional Warm-Up† tempered water bath or hot air	2:00 to 6:00	38 to 45 (100.4 to 113)
FLEXICOLOR Developer	3:15‡	37.8 ±0.15 (100.0 ±0.25)
FLEXICOLOR RA Bleach NR§	1:00	38 ±3 (100.0 ±5)
FLEXICOLOR RA Fixer§	2:00	38 ±3 (100.0 ±5)
Wash	2:00	38 ±3 (100.0 ±5)
FLEXICOLOR Stabilizer III¶	1:00	24 to 38 (75 to 100)
Dry	As needed	20 to 60 (68 to 140)

* Times include a 10-second drain time at the end of each step. Solution volume depends on the type of processor.

† Tube is loaded with film and ready for processing. Determine the best time by calibrating the tube. See *Process Control and Adjustment*. **Do not immerse the film in a warm water pre-soak. Warm-up step is done by warming the outside of the tube with hot air or in a tempered water bath**.

‡ Determine the correct time for your processor by running a test with your tube. See *Process Control and Adjustment*.

§ Use only FLEXICOLOR RA Bleach Replenisher NR and FLEXICOLOR RA Fixer and Replenisher.

¶ If stabilizer foaming in the tube is a problem, you can stabilize the film in a separate tank.

Process Control and Adjustment

Determine Your Operating Conditions—In order to control and optimize the process, you need to establish consistent operating conditions. Choose the tube you use most frequently and select a location in the tube (preferably at either end) to position the film or control strip for testing. Process all test films or control strips in that position on all future processing runs. Using a different position or different tube may affect the results.

Monitoring Procedures—Follow the procedures for using KODAK Control Strips, Process C-41, given in Section 5, *Process Monitoring and Troubleshooting*. Include a control strip with each processing run and plot the control-strip density readings on a process control chart.

Developer Temperature and Time—In some rotary-tube processors, maintaining the developer temperature at 37.8 ± 0.15°C (100 ± 0.25°F) can be difficult, and often some loss of developer temperature occurs. The amount of developer-temperature loss can vary based on the design of the rotary-tube processor and the ambient conditions. Since the developer is the most critical step in the process, compensating for developer-temperature loss will help to optimize the performance of the process and improve the quality of the processed film.

The best way to compensate for loss of developer temperature is by increasing the developer time (from the standard time of 3:15). The amount of developer-time extension can be determined approximately by the visual appearance of the density of processed film. The preferred method for determining the exact amount of developer-time extension required is to use KODAK Controls Strips. Process C-41 to monitor the process.

If the control-strip density values plot within the process-control limits for LD and HD – LD, you do not need to adjust the developer time. If the LD and HD – LD parameters plot significantly low (out of control limits), then increase the developer time slightly on each subsequent process run until the control-strip plots are in control. Usually an adjusted developer time that produces good control-strip densities falls somewhere between 3:15 and 3:45.

If you find that you cannot get the control-strip densities to plot within the control limits by extending the developer time to 3:45, or if other unusual LD and HD – LD density readings occur, check for process conditions that may be abnormal. Check to make sure that the starting developer temperature and time are normal and check for developer mixing errors or developer contamination. Also check for mixing errors in the bleach or fixer, or loss of bleach or fixer activity. See Section 5, *Process Monitoring and Troubleshooting*, for more information about troubleshooting your process.

Push-Processing KODAK PROFESSIONAL PORTRA Films in Rotary-Tube Processors

KODAK PROFESSIONAL PORTRA 400UC AND PORTRA 800 Films are designed so that you can push-process them to higher exposure indexes. You can push-process PORTRA 400UC Film to an exposure index of 800, and PORTRA 800 Film to exposure indexes of 1600 and 3200, and produce negatives that yield good-quality prints.

To push-process these films, extend the development time for the exposure index you used according to the following table. Keep the times for all other solutions the same as those for a normal process.

KODAK Film	Exposed at (EI)	Development Time (min:sec)
PROFESSIONAL PORTRA 400UC	400	3:15*
	800	3:45
PROFESSIONAL PORTRA 800	800	3:15*
	1600	3:45
	3200	4:15

* You may need to adjust the normal development time as described in *Process Control and Adjustment*. Add the adjusted normal development time to the amount of time for push processing.

Note: These push-process times are starting points. Make tests to determine the best development time for your application.

4 MINILAB PROCESSORS

There are many different types of minilab processors, and they are used under a variety of conditions. KODAK Chemicals are designed to offer you choices to get the best results from your minilab regardless of its operation.

WHICH PROCESS CYCLE SHOULD YOU USE FOR YOUR PROCESSOR?

There are three basic processing cycles for processing Kodak color negative films in minilabs. You can use each of these cycles in minilabs that operate with or without wash water. The description of the three cycles will help you decide which matches your particular processor and processing conditions.

Do not process KODAK VERICOLOR Slide Film / SO-279/5072 in washless minilab process cycles that use FLEXICOLOR Final Rinse and Replenisher, i.e., Process C-41B and Process C-41RA. Process these films in Process C-41 only using FLEXICOLOR Stabilizer III and Replenisher.

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

Process C-41RA

This film process cycle is the shortest of the Process C-41 cycles, and the one most commonly used in minilabs. You must use KODAK FLEXICOLOR RA Bleach Replenisher NR and KODAK FLEXICOLOR RA Fixer and Replenisher in this cycle.

Process C-41RA requires special equipment that accommodates the shorter solution times, and the processor must provide higher agitation in the bleach, fixer, and final rinse. Check with your minilab manufacturer to determine if your processor meets Process C-41RA specifications.

Although Process C-41RA is intended to be a washless cycle, you can use it with a processor that includes a final wash if it meets the time and agitation requirements.

Table 4-1 Process C-41RA Cycle

Solution/Step	Time* min:sec	Temperature °C (°F)
FLEXICOLOR Developer Replenisher LORR	3:15	37.8 ±0.15 (100.0 ±0.25)
FLEXICOLOR RA Bleach Replenisher NR†	1:00	38 ±3 (100 ±5)
FLEXICOLOR RA Fixer and Replenisher‡	1:30 to 2:00	38 ±3 (100 ±5)
FLEXICOLOR Final Rinse and Replenisher§	1:00	38 ±3 (100 ±5)
Dry	As needed	40 to 68 (104 to 155)

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

† Use only KODAK FLEXICOLOR RA Bleach Replenisher NR. Your equipment must provide the higher agitation required for this solution.

‡ Use only KODAK FLEXICOLOR RA Fixer and Replenisher. Use two countercurrent-flow fixer tanks with equal times in both tanks (0:45 to 1:00 in each tank). Your equipment must provide the higher agitation required for this solution.

§ Use three countercurrent-flow final rinse tanks with equal times in all tanks (0:20). Your equipment must provide the higher agitation required for this solution. Replenish the third final rinse tank at 40 mL/135-24 roll (36 mL/m). If your processor has two countercurrent-flow final rinse tanks followed by a single tank, replenish the second countercurrent tank at 40 mL/135-24 roll (36 mL/m) and the single tank at 20 mL/135-24 roll (18 mL/m). For minilabs with a final wash after the fixer, use a wash time of 1:40 and reduce the final rinse time to 40 seconds. Use a wash rate of 1250 mL/135-24 roll (330 mL/ft) for a two-stage countercurrent-flow wash. Double this rate for a single wash. Use a final rinse replenishment rate of 33 mL/135-24 roll.

Table 4-2 Starting-Point Replenishment Rates—Process C-41RA

Solution	Starting-Point Replenishment Rate	
	mL/135-24 Roll (mL/m)	mL/25-Exp ADVANTIX Film (mL/m)*
FLEXICOLOR Developer Replenisher LORR	20 (18)	11.1 (10.2)
FLEXICOLOR RA Bleach Replenisher NR	5 (4.5)	3.4 (3.1)
FLEXICOLOR RA Fixer and Replenisher	35 (32)	24 (22)
FLEXICOLOR Final Rinse and Replenisher	40 (36)	27 (25)

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

Process C-41B

The primary feature of this cycle is that it is shorter than the standard Process C-41 cycle. It eliminates both washes and uses a shorter fixer time. Most minilabs that use Process C-41B use the washless version. However, if your minilab includes a final wash, see the fourth footnote below.

Table 4-3 Process C-41B Cycle

Solution/Step	Time* min:sec	Temperature °C (°F)
FLEXICOLOR Developer Replenisher LORR	3:15	37.8 ±0.15 (100.0 ±0.25)
FLEXICOLOR Bleach III NR Replenisher	3:00 to 4:20	38 ±3 (100 ±5)
FLEXICOLOR Fixer and Replenisher†	4:00 to 4:20	38 ±3 (100 ±5)
FLEXICOLOR Final Rinse and Replenisher‡,§	2:20	38 ±3 (100 ±5)
Dry	As needed	40 to 68 (104 to 155)

* Immersion time plus crossover time to the next tank. Bleach, fixer, and final rinse times are minimums; longer times are acceptable.
† Use two countercurrent-flow fixer tanks with equal times in both tanks (2:00 to 2:10 in each tank).
‡ Use three countercurrent-flow final rinse tanks with equal times in all tanks (0:47 in each tank).
§ If your minilab uses a final wash, also install a wash between the fixer and final rinse with a wash time of 1:40. Reduce the final rinse time to 40 seconds, and use a replenishment rate of 35 mL/135-24 roll (32 mL/m). Use a wash-flow rate of 1250 mL/135-25 roll (1080 mL/m) for a two-stage countercurrent wash or 2500 mL/135-24 roll (2160 mL/m) for a single-stage wash.

Table 4-4 Starting-Point Replenishment Rates—Process C-41B

Solution	Starting-Point Replenishment Rate	
	mL/135-24 Roll (mL/m)	mL/25-Exp ADVANTIX Film (mL/m)*
FLEXICOLOR Developer Replenisher LORR	20 (18)	11.1 (10.2)
FLEXICOLOR Bleach III NR Replenisher	5 (4.5)	3.4 (3.1)
FLEXICOLOR Fixer and Replenisher	35 (32)	24 (22)
FLEXICOLOR Final Rinse and Replenisher	40 (36)	27 (25)

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

Process C-41

This process cycle is sometimes used in older minilabs. It most commonly includes water washes. To use the washless version of this cycle, follow the recommendations in the second footnote under the table.

Table 4-5 Process C-41 Cycle

Solution/Step	Time* min:sec	Temperature °C (°F)
FLEXICOLOR Developer Replenisher LORR	3:15	37.8 ±0.15 (100.0 ±0.25)
FLEXICOLOR Bleach III NR Replenisher	4:20 to 6:30	38 ±3 (100 ±5)
Wash†	1:00 to 3:15	24 to 41 (75 to 105)
FLEXICOLOR Fixer and Replenisher‡	4:20 to 6:30	38 ±3 (100 ±5)
Wash†	2:10 to 3:15	24 to 41 (75 to 105)
FLEXICOLOR Final Rinse and Replenisher	1:05	24 to 41 (75 to 105)
Dry	As needed	40 to 68 (104 to 155)

* Immersion time plus crossover time to the next tank. Bleach, fixer, and final rinse times are minimums; longer times are acceptable.
† Use a two-stage countercurrent-flow wash. For a single-stage wash, double the replenishment rate. If your minilab uses a final rinse step *instead of* a final wash, eliminate both washes. Use three countercurrent-flow final rinse tanks with a minimum final rinse time of 2:20 (0:47 in each tank). Use a final rinse temperature of 38 ±3°C (100 ±5°F) and a replenishment rate of 40 mL/135-24 roll (36 mL/m).
‡ Use two countercurrent-flow fixer tanks with equal times in both tanks (2:10 to 3:15).

Table 4-6 Starting-Point Replenishment Rates—Process C-41

Solution/Step	Starting-Point Replenishment Rate	
	mL/135-24 Roll (mL/m)	mL/25-Exp ADVANTIX Film (mL/m)*
FLEXICOLOR Developer Replenisher LORR	20 (18)	11.1 (10.2)
FLEXICOLOR Bleach III NR Replenisher	5 (4.5)	3.4 (3.1)
Wash	1250 (1080)†	850 (734)†
FLEXICOLOR Fixer and Replenisher	35 (32)	24 (22)
Wash	1250 (1080)†	850 (734)†
FLEXICOLOR Final Rinse and Replenisher	35 (32)‡	27 (25)‡

* These rates are averages based on an estimated film-speed mix in 25-exposure rolls of KODAK ADVANTIX Films.
† For a two-stage countercurrent-flow wash. Double this rate for a single-stage wash.
‡ If your minilab uses a final rinse *instead of washes,* use a replenishment rate of 40 mL/135-24 roll (36 mL/m) or 27 mL/25-exposure roll (25 mL/m) of ADVANTIX Film.

MAINTAINING EQUIPMENT USED WITH ADVANCED PHOTO SYSTEM™ FILMS

The Advanced Photo System (APS) offers several features that are not available in 35 mm or other film systems, including the ability to record information on a transparent magnetic layer on the film base. The information recorded by APS cameras includes some or all of the following:

- print format (C/H/P)
- exposed date and time
- roll title and frame number
- number of prints to be made from each exposure
- scene information

To deliver all the Advanced Photo System features consistently and reliably, the photofinishing equipment must read this information correctly. This requires special attention during film handling, as well as routine and thorough maintenance of the processing and printing equipment to keep it clean and working reliably. The following guidelines will help ensure that your equipment can read the magnetic information properly.

Maintaining the Film Processor

To ensure that the film is free from residue that can interfere with the operation of printing equipment, proper maintenance of the processor is very important.

Clean the processor squeegees or squeegee rollers daily. Contaminated or deteriorated squeegee rollers that are not able to remove excess final rinse can lead to the formation of residue (scum) on the surface of the film. This residue may adhere to the magnetic head in the printer and affect its ability to read information on the film. Follow the daily start-up and shutdown procedures recommended by your processor manufacturer for maintaining the squeegee rack.

Debris can also collect on squeegee rollers if the processor is idle for a long time. Solution remaining on the squeegee rollers may be crystallized, or the solution soaked into the rollers may be concentrated due to evaporation. When starting the processor after a shutdown, wash the squeegee rollers according the manufacturer's recommendations.

Regularly maintain the solution levels in the processing tanks. Top off the solutions with water at start-up and shutdown. Overconcentrated final rinse can leave residue on the film surfaces, which can transfer to the magnetic head in the printer and interfere with its operation. Follow the processor manufacturer's instructions for minimizing evaporation and oxidation.

Use a clean water supply to mix the chemicals. Impurities (such as dirt or calcium particles) in the final rinse may dry on the film as it goes through the dryer. These impurities may become loose and stick to the magnetic head in the printer. If your water contains high levels of impurities, we recommend that you use an alternate water supply or use deionized or distilled water.

Use proper solution replenishment. Confirm that the replenishment rates are correct for the rolls of APS films in your product mix.

Replace the final rinse periodically. Dirt, skiving, biological growth, and other foreign materials can accumulate in the final rinse over time. To avoid biological growth in the tank and dirt problems on film, we recommend that you dump and replace the final rinse at least once a month. Clean the tank and rollers thoroughly before replacing the solution. Some labs may require more frequent dumping if the final rinse tends to form precipitates.

Maintaining Printing Equipment

The magnetic head inside the printer film deck must be able to read the magnetic information recorded on APS films. Dirt or debris can cause magnetic-data reading errors.

Keep the magnetic heads clean. Residue on the film after processing can cause too large a separation between the reading head and the film surface. This can lead to errors in reading the low-level magnetic signal on the film. Residue and debris can also become loose and stick to the magnetic head in the printer.

Follow the maintenance and cleaning procedures recommended by the manufacturer of your printer. *Manufacturers generally recommend cleaning the magnetic heads at the beginning of each shift to prevent magnetic-data reading errors.*

Note: Residue on film can affect the print quality of all films. However, in the case of APS film, the effect on magnetic reading will generally occur before any visible effect on print quality.

Clean the reattacher magnetic heads. After processing, APS films are reattached to the original cassette before the negatives are exposed in the minilab printer.

Noritsu makes several models of reattach fixtures. One model, the FARA-300, can clean some processing debris off the film surface within 3 mm of the film edge. This cleaning greatly facilitates the magnetic data exchange between the processed film and the printer that occurs during the next operation.

You can reach the subassembly that reattaches and cleans the film by unlatching the top cover and swinging it up. Two metallic-colored pads are located directly behind the drive rollers in the base of the unit, and two metallic spring-loaded pads are in the top cover opposite the pads in the base of the unit. Clean all four pads with a cotton swab soaked in alcohol. Clean the four pads after every shift, or after every 1000 APS rolls that are reattached, whichever occurs sooner.

5 PROCESS MONITORING AND TROUBLESHOOTING

To produce high-quality color negatives consistently, you need to match your process to a standard for density, color, and contrast each time you process film. 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.

This section describes standards and methods for setting up your process and for ongoing process monitoring. The primary tools for monitoring your process are KODAK Control Strips, Process C-41, and the reference strip. This section describes how to use these strips and interpret the results.

PROCESS-MONITORING TERMS

The following terms are frequently 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 (within 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.

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

Control Limits—The control limits define the maximum tolerances that are acceptable for processing customer work. If any density value of your process plots beyond the control limit, the process is out of control. Results will be unsatisfactory for color, density, or contrast. When any density value plots beyond the control limit, 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 or roll of control strips. *Correction factors are issued for each code number.*

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—These are density variations permitted before you must take corrective action. They include an aim-value adjustment tolerance, and action and control limits. The tolerances and limits listed in Table 5-1 apply to KODAK Control Strips, Process C-41.

Table 5-1 Tolerances and Limits for KODAK Control Strips, Process C-41

Measurement	Aim-Value Adjustment Tolerance	Action Limits	Control Limits	Color-Balance Spread Limit
D-min	± 0.03	+ 0.03	+ 0.05	NA
LD	± 0.04	± 0.06	± 0.08	NA
HD – LD	± 0.03	± 0.07	± 0.09	0.09
$D\text{-}max_B - Y_B$	± 0.07	+ 0.10	+ 0.12	NA

NA = Not applicable

KODAK CONTROL STRIPS, PROCESS C-41

Use KODAK Control Strips, Process C-41, to monitor Processes C-41, C-41B, and C-41RA. By plotting the densities of the different steps of the strip, you can monitor the D-min, speed (LD), and contrast (HD – LD) of your process, and detect retained silver (by calculating and plotting $D\text{-}max_B - Y_B$).

KODAK Control Strips, Process C-41 (35 mm) (CAT No. 180 3709)

These 35 mm strips are supplied in 100-foot rolls of approximately 120 strips with cutoff notches at $9\frac{1}{2}$-inch (24.1 cm) intervals. A reference strip is included with each roll. The roll is wound *emulsion side in,* with the D-min ends of the strips toward the outer end of the roll.

Each strip has 12 density steps: a yellow step or yellow patch; 10 equal-increment density steps; and a D-min area. The 10 equal-increment density steps include a D-max step at the top, as well as the HD and LD steps, which are marked by a "U" or notch. The D-min area is the area adjacent to the black dot near the bottom of the strip.

KODAK Control Strips, Process C-41 (CAT No. 151 9677)

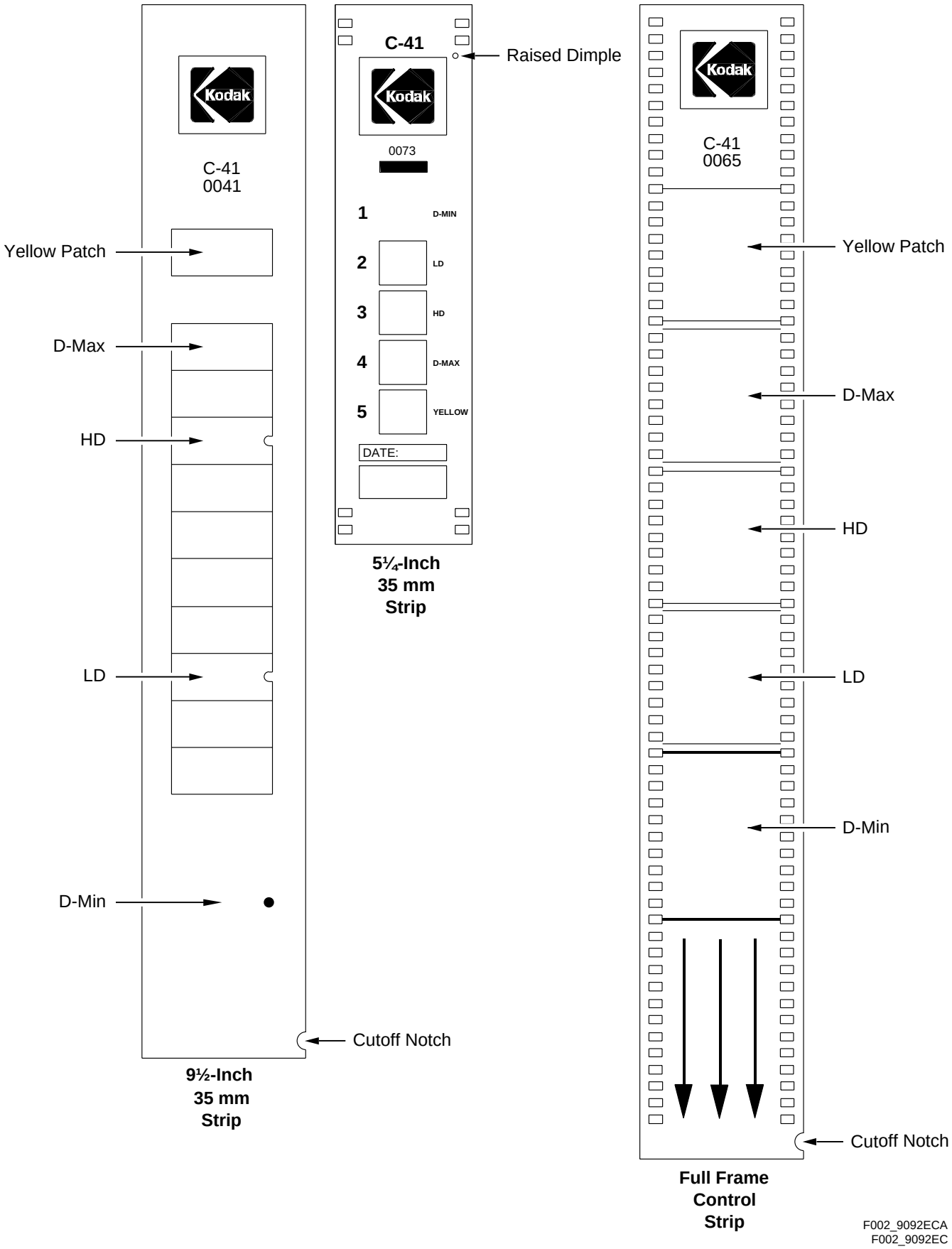
These 35 mm x $5\frac{1}{4}$-inch strips are supplied in a box of five foil packages that contain 10 strips each. Each box includes a reference strip. The ends of the strips are perforated for use with standard control-strip racks. Each strip has five steps: D-min, LD, HD, D-max, and yellow. A raised dimple is located on the emulsion side at the low-density end of the strip.

KODAK Full Frame Control Strips, Process C-41 (35 mm) (CAT No. 157 6701)

These 35 mm strips are supplied in 100-foot rolls of approximately 80 strips with cutoff notches at 15-inch (38.1 cm) intervals. The roll is wound *emulsion side in,* with the D-min ends of the strips toward the outer end of the roll. A reference strip is included with each roll.

Each strip has five full-frame density steps: D-min, LD, HD, D-max, and yellow. These strips are designed primarily for use with minilab system printers that use a film scanner as a built-in densitometer. However, you can use them with any densitometer that can read large-area transmission density.

Figure 5-1 KODAK Control Strips, Process C-41



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; reseal and return the package to the freezer as quickly as possible. Do not keep the package out of the freezer for more than 1 hour per day. Store your daily supply of control strips in a lighttight container at room temperature. At the end of the day, discard any unprocessed strips that you removed from the freezer.

Handle control strips by the edges to prevent fingerprints and surface damage. If film sticking, static marking, or moisture mottle occurs, allow the strips to warm up to room temperature before you process them.

When your shipment of control strips arrives, remove the reference strip from the box before you put the control-strip boxes in the freezer. Store the reference strip in its envelope when you are not using it.

Starting Out

To begin process monitoring, you will need—

- KODAK Control Strips, Process C-41
- An electronic densitometer equipped with Status M filters
- KODAK Process Record Form Y-55 or similar graph paper
- Red, green, and blue pencils

You can also plot your process by using the procedure in the KODATEL Quality Management System.

Processing Control Strips

Each time you process a control strip, position it in the same location in your processor. In continuous processors, process the D-min end of the strip first; in rack-and-tank processors, fasten the strip to a film clip with the D-min end up.

Process 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. Follow the procedure given below. Your chart will look like the examples shown in this section.

1. Draw in the action and control limits given in Table 5-1. Use black for the action limits and red for the control limits.
2. Remove the reference strip from the box of control strips. If you removed the box from cold storage, allow the reference strip to warm up to room temperature before you remove it from its envelope (about 15 minutes). Exposing a frozen strip to warm, moist air can cause low readings, particularly in the higher-density patches.
3. Measure the Status M densities in the center of each patch with a precision electronic densitometer. **Do not** move the strip as you make the density reading or you may affect the precision and repeatability of the measurements. Measure the blue density of the D-max ($D\text{-}max_B$) and yellow (Y_B) steps, and measure the red, green, and blue densities of the LD, HD, and D-min steps. If you have several boxes of strips with the same code number, average the readings of all the reference strips. A code number on the box label and the reference and control strips identifies each batch.
4. To calculate aim values, add the correction factors supplied in the instruction sheet packaged with each box of control strips to the reference-strip densities. Note the sign of the correction factor. If it is negative, you need to subtract the correction factor. 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 densities from the adjusted HD densities.
   - To obtain the $D\text{-}max_B - Y_B$ aim value, subtract the adjusted blue-filter density of the yellow step from the adjusted blue-filter density of the D-max step.
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, determine the cause of the problem. The diagnostic charts and control-chart examples in this section will help you troubleshoot your process problems.
8. Whenever you take corrective action, process another control strip to confirm that the change you made returned the process to control before you resume normal processing. See *Control-Chart Examples*.

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 code numbers provide the same information. The following procedure allows you to make adjustments for minor code-to-code variations. Using the crossover procedure in the KODATEL Quality Management System will simplify the process.

Be sure that your process is stable and in control before you begin using a new batch of control strips.

1. While you still have a week's supply of control strips of your 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 by following steps 2 through 4 under *Plotting Control-Strip Densities*.
4. For your current batch of 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, and then divide the result by 2.
7. Depending on the sign of the differences, adjust the aim values for the new batch of strips by adding or subtracting the results from step 6. The amount of the adjustment should not exceed the aim-value adjustment tolerances given in Table 5-1. 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 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 Table 5-2. An example is given to help you. You may also want to make copies of the table and use them as worksheets.

Table 5-2

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 always plot within the control limits.

Corrective Action

When a control strip plots outside the control limits, or if the plot shows a gradual drift toward an out-of-control condition, immediately check for the cause and correct it. First, determine if the process drifted out of control slowly over time or if it occurred suddenly.

Gradual Change

Gradual changes to an out-of-control condition indicate a problem that could be caused by the following:

Improper replenishment—Check that the replenishment rate is correct and that the replenishment system is operating properly. Also check for an incorrectly 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 leach slowly into the solutions. The contaminant may come from any material that is in contact with the solutions, such as the 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 replenisher solution that was mixed incorrectly, mix a new batch of replenisher to see if a fresh mix gradually corrects the problem.

Sudden Change

Sudden changes to an out-of-control condition indicate a problem that can be caused by the following:

Control strip—Check that you used a control strip from the correct 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, and 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 M filters.

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

Agitation—Check that pumps are working and that the burst distribution, duration, and interval are correct.

Contamination—Very small amounts of bleach or fixer can contaminate the developer tank or replenisher solution and cause a large density and color shift.

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.

To help determine the cause of an out-of-control condition, use the information under *Diagnostic Charts* and the sample plots under *Control-Chart Examples*. The diagnostic charts are flowcharts that list problems and lead you through possible causes and solutions. The control-chart examples demonstrate the effects of a single condition on control-strip plots. If your chart shows a similar effect, you may be able to tell if your process is affected by the same problem. However, sometimes a diagnosis is more difficult, because a problem may have more than one cause.

Daily Processing Log

Use a daily processing log for your processor. A processing log will provide you with a convenient means of keeping track of the amount of film you process and can provide you with valuable information in case of process and/or machine problems.

How Each Processing Solution Affects Your Results

Each solution affects the emulsion differently. Understanding the reaction of each solution can help you diagnose processing problems. See the process specifications listed in Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*; Section 3, *Sink-Line, Batch, and Rotary-Tube Processors*; and Section 4, *Minilab Processors*.

Developer

The developer chemically reduces the exposed silver halide in the film to form a metallic silver image. At the same time, the color developing agent in the developer oxidizes and combines with color couplers at the site of the silver image in each of the dye-forming emulsion layers to form a color-dye image. Once the dye image has formed, there is no need for the silver image. It is removed later 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 and the density values will plot higher than normal. With *too little* activity, not enough dye forms and the density values will plot lower than normal.

Bleach

The bleach stops the developer activity and converts metallic silver back to silver halide. The silver halide is later dissolved in the fixer.

Bleach concentration and the rate at which the solution diffuses into the emulsion affect bleach activity. Time, agitation, and temperature affect the rate of diffusion. Replenishment rate, mixing procedures, and aeration efficiency affect the chemical concentrations. Bleach aeration adds oxygen needed to convert the reduced bleaching agent to an active form.

If bleaching is inadequate, less than the normal amount of cyan dye is formed because some of the dye remains in the leuco (colorless) condition. This adversely affects the color balance. Bleach time that is too short, bleach that is too dilute, or insufficient bleach aeration can cause leuco-cyan dye to form.

Inadequate bleaching can also cause retained silver because not all the metallic silver is converted to silver halide. Leuco-cyan dye and retained silver adversely affect image quality, but you can correct both conditions by rebleaching and refixing the film in good solutions.

Bleach Aeration—In Process C-41, you must aerate the bleach to convert iron II back to iron III, the bleaching agent. If the concentration of iron II is not kept near zero, leuco-cyan dye is likely to form.

Fixer

The fixer converts silver halide in the film into soluble silver complexes that are washed from the film. You can recover the silver with electrolytic silver-recovery units and/or chemical-recovery cartridges. Fixing efficiency depends on fixer activity and the diffusion rate into the emulsion. Temperature, replenisher concentration, and replenishment rate affect fixer activity. Time and agitation affect the diffusion rate.

Inadequate fixing may not remove all of the sensitizing dyes and silver halide. An increase in the red and green D-min densities of the control plot is one sign of incomplete fixing. Another sign is a milky appearance in the D-min areas of control strips and processed film. If this problem occurs, you can test the fixer by refixing the control strip (or film) in a fixer that you are sure is good. If refixing the strip corrects the control plot, the original fixer is probably exhausted. You can correct inadequately fixed film by refixing it.

The most probable causes of inadequate fixing are fixer that is diluted by excessive solution carryover, an inadequate fixing time, underreplenishment, a replenisher that is underconcentrated, and fixer sulfurization. Temperature has very little effect on the fixing rate if other fixer conditions are within tolerances. Agitation is necessary for uniform fixing.

Wash

Washing removes residual chemicals from the film. If the chemicals are not removed, they can degrade the image and cause the dyes 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 moves freely into the emulsion to remove the chemicals, but not so warm that the gelatin melts or is permanently distorted.

For rack-and-tank processors, be sure that the entire rack is washed; if bleach or fixer is trapped on hanger clips, the solution can run down onto the film. Also, if the solution dries on the hangers, it can be carried back into the developer and can cause severe contamination. To avoid this problem, keep the level of the final wash high enough so that the entire rack is immersed during washing or you can spray-wash the rack just before it enters the dryer. If your processor uses a leader film, be sure to wash it thoroughly before you reuse it.

Stabilizer/Final Rinse

The stabilizer or final rinse has no sensitometric effect on the film, but has the greatest impact on the physical quality of processed film. If the stabilizer or final rinse is underreplenished, or if it contains particulate material from a “dirty” water supply or biological growth, it can leave drying marks and deposits on processed film.

DIAGNOSTIC CHARTS

The diagrams in this section provide you with a step-by-step approach to diagnosing processing problems. Summary charts show which detailed chart to consult for your problem. The charts give probable causes and suggest corrective procedures. Remedies for some processing problems are described in Section 1, *KODAK FLEXICOLOR Chemicals*.

Chart	Example
A	Control-Chart Plots—Preliminary
B	Control-Chart Plots—Summary
C	Control-Chart Plots—Retained Silver
D	Control-Chart Plots—High Activity
E	Control-Chart Plots—Color Spread
F	Control-Chart Plots—Low Activity
G	Visual Appearance—Processing Solutions—Summary
H	Visual Appearance—Developer
I	Visual Appearance—Bleach
J	Visual Appearance—Fixer, Stabilizer, and Final Rinse
K	Visual Appearance—Film—Summary
L	Visual Appearance—Film—Scratches and Abrasions
M	Visual Appearance—Film—Surface Dirt and Adhesive Transfer
N	Visual Appearance—Film—Emulsion-Side Problems
O	Visual Appearance—Film—Drying Marks
P	Visual Appearance—Film—Scum
Q	Visual Appearance—Film—Pressure Marks, Fog, Static
R	Physical Appearance—Film—Sticking

Chart A
Control-Chart Plots—Preliminary

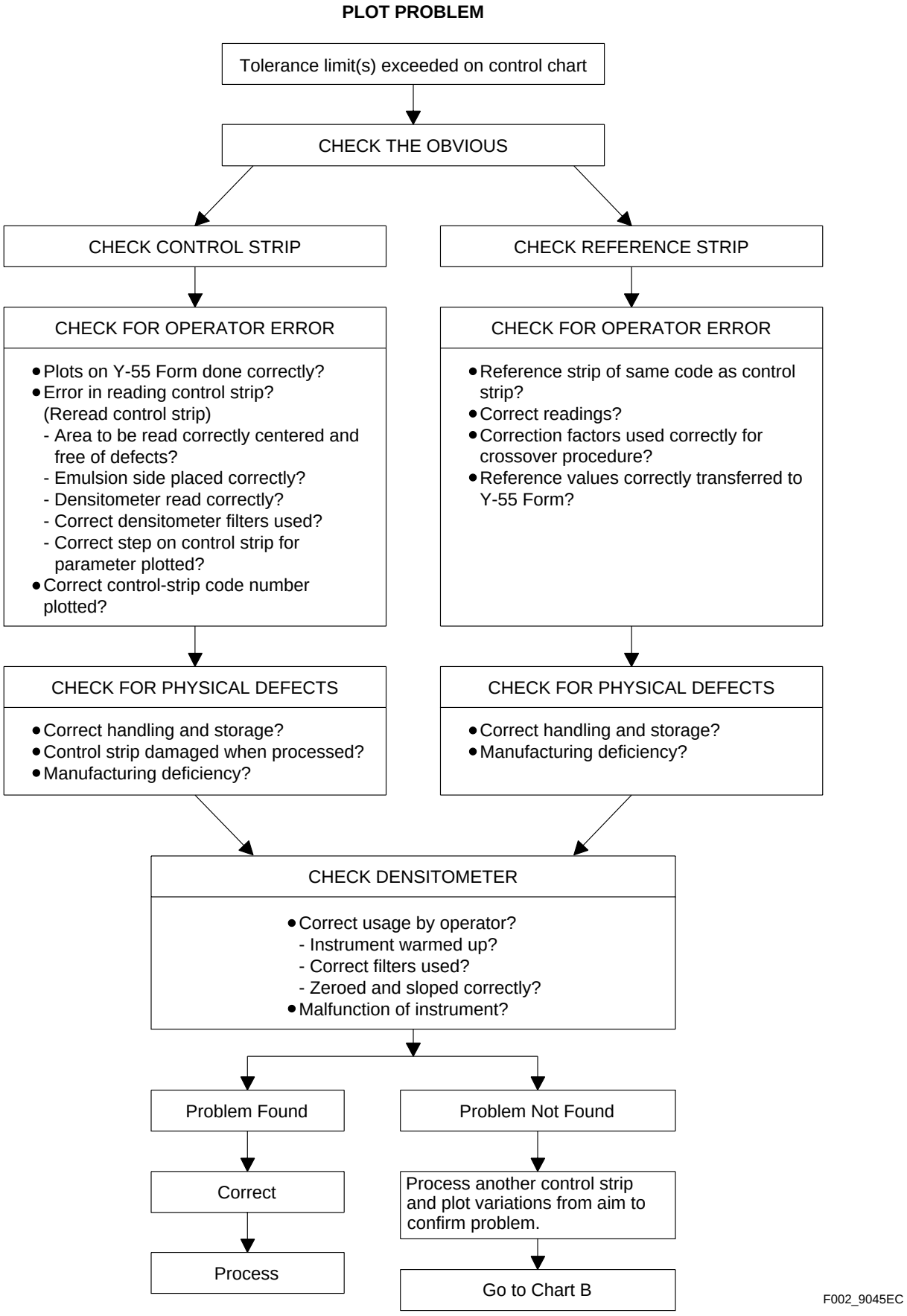
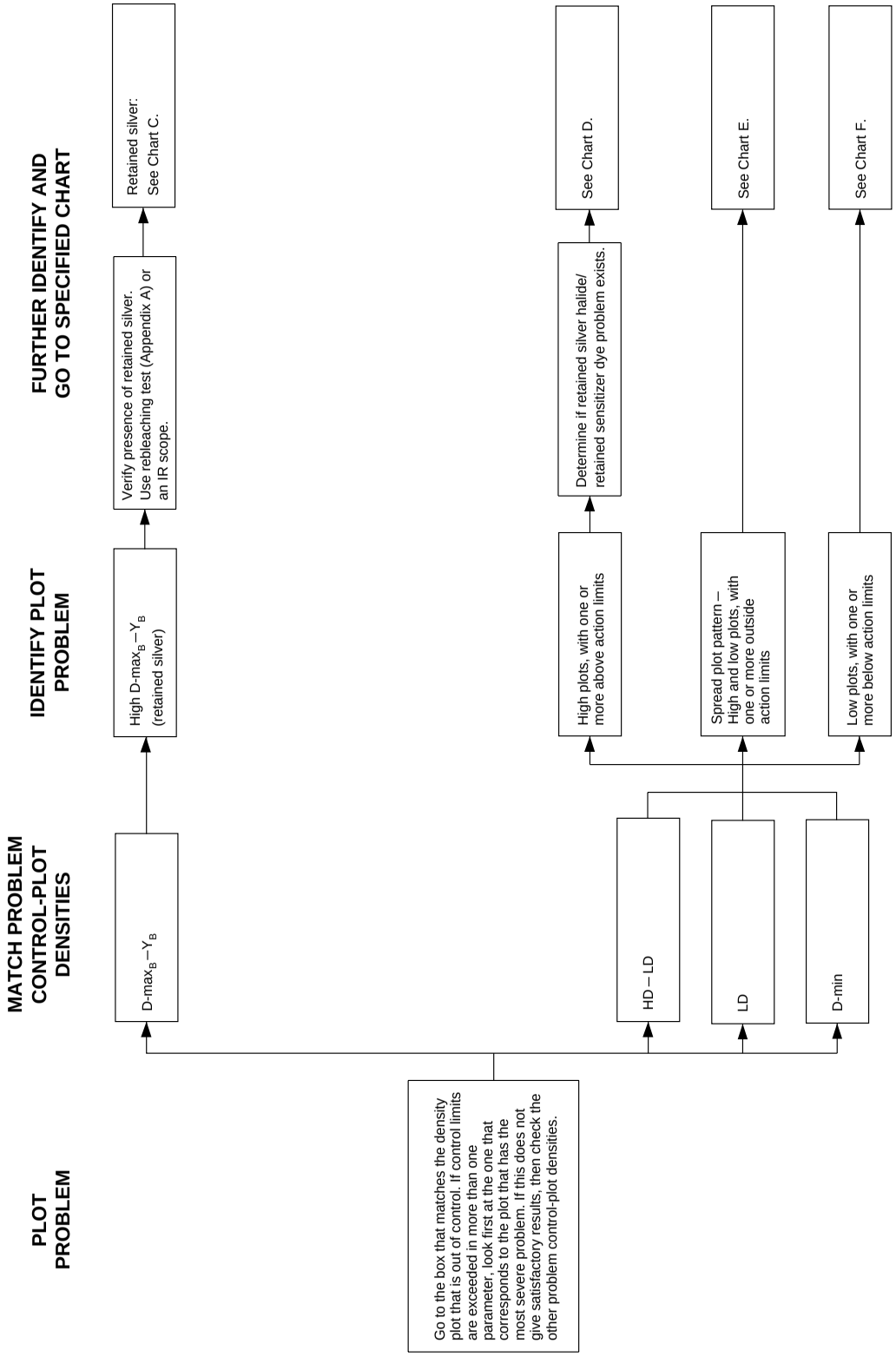


Chart B
Control-Charts Plots—Summary



F002_9046EC

Chart C
Control-Charts Plots—Retained Silver

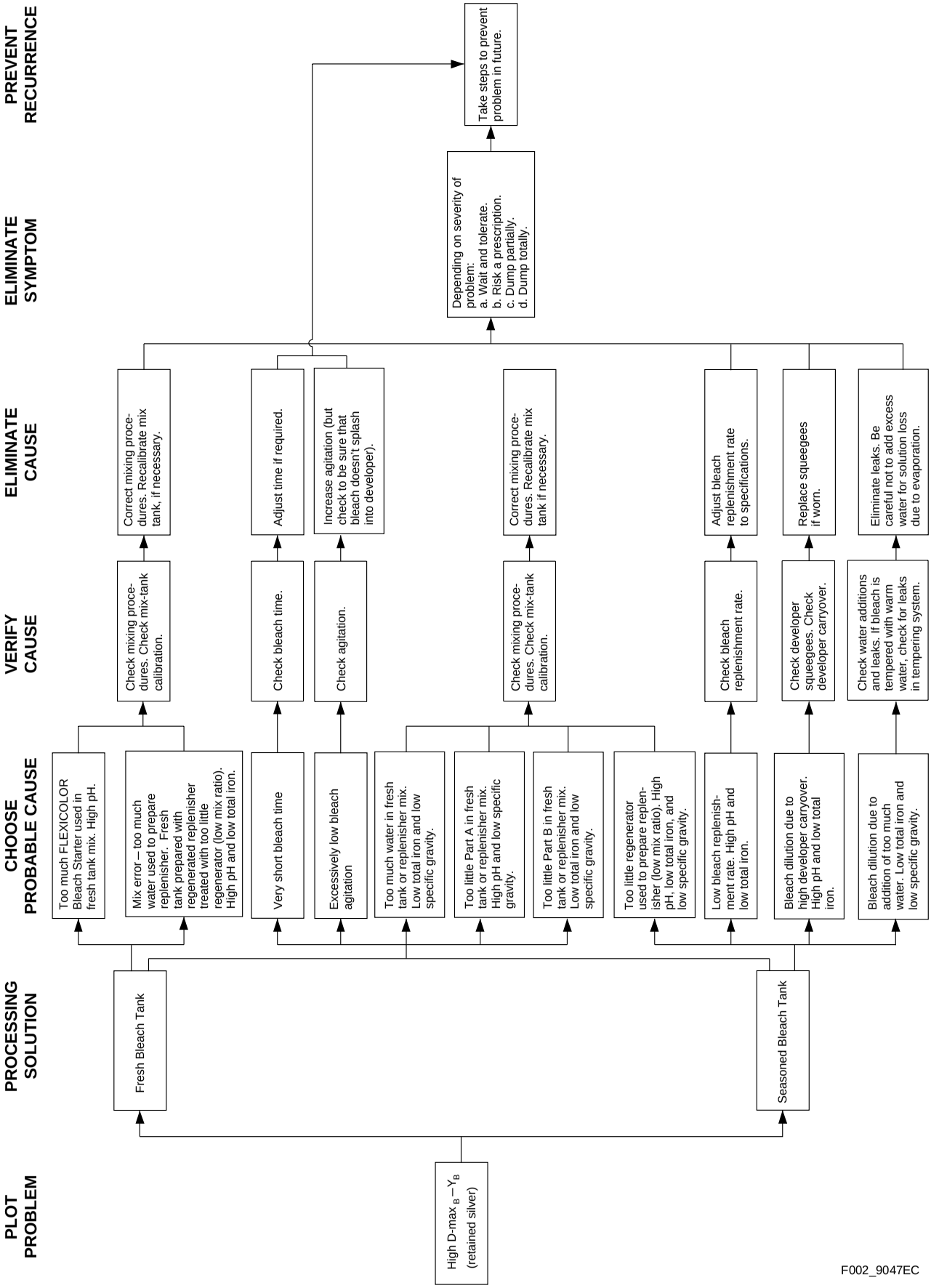


Chart D
Control-Charts Plots—High Activity

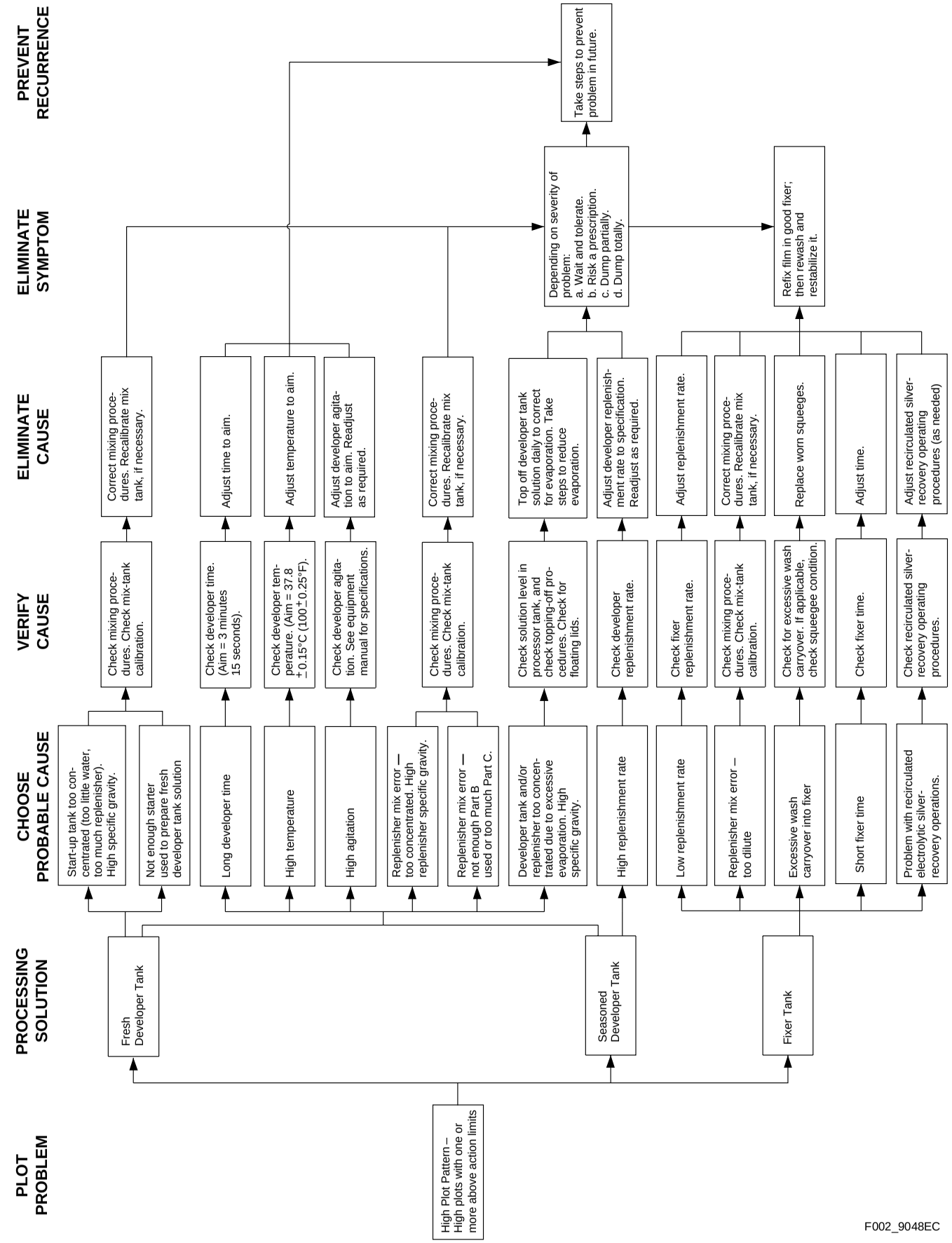


Chart E

Control-Charts Plots—Color Spread

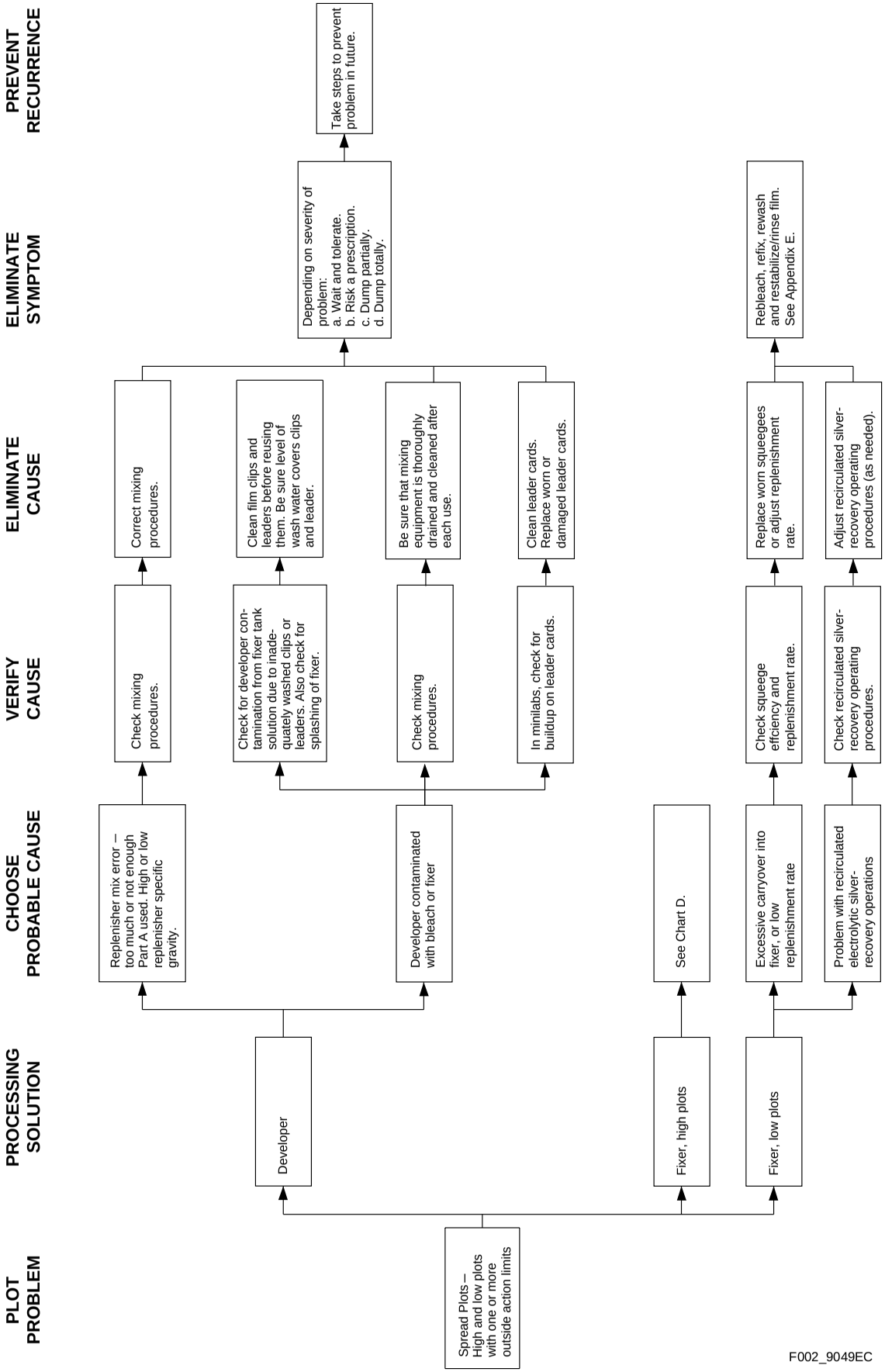


Chart F
Control-Charts Plots—Low Activity

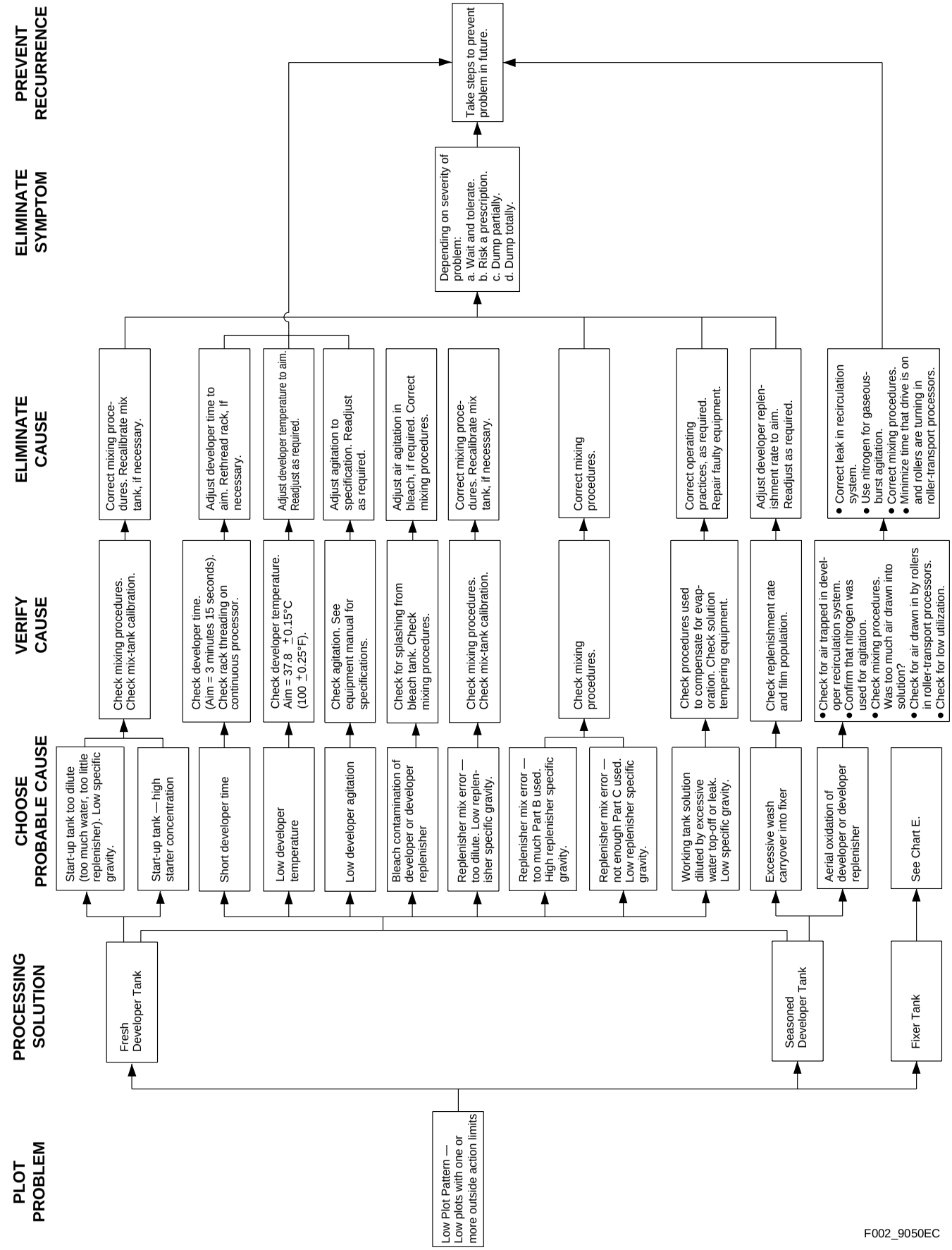
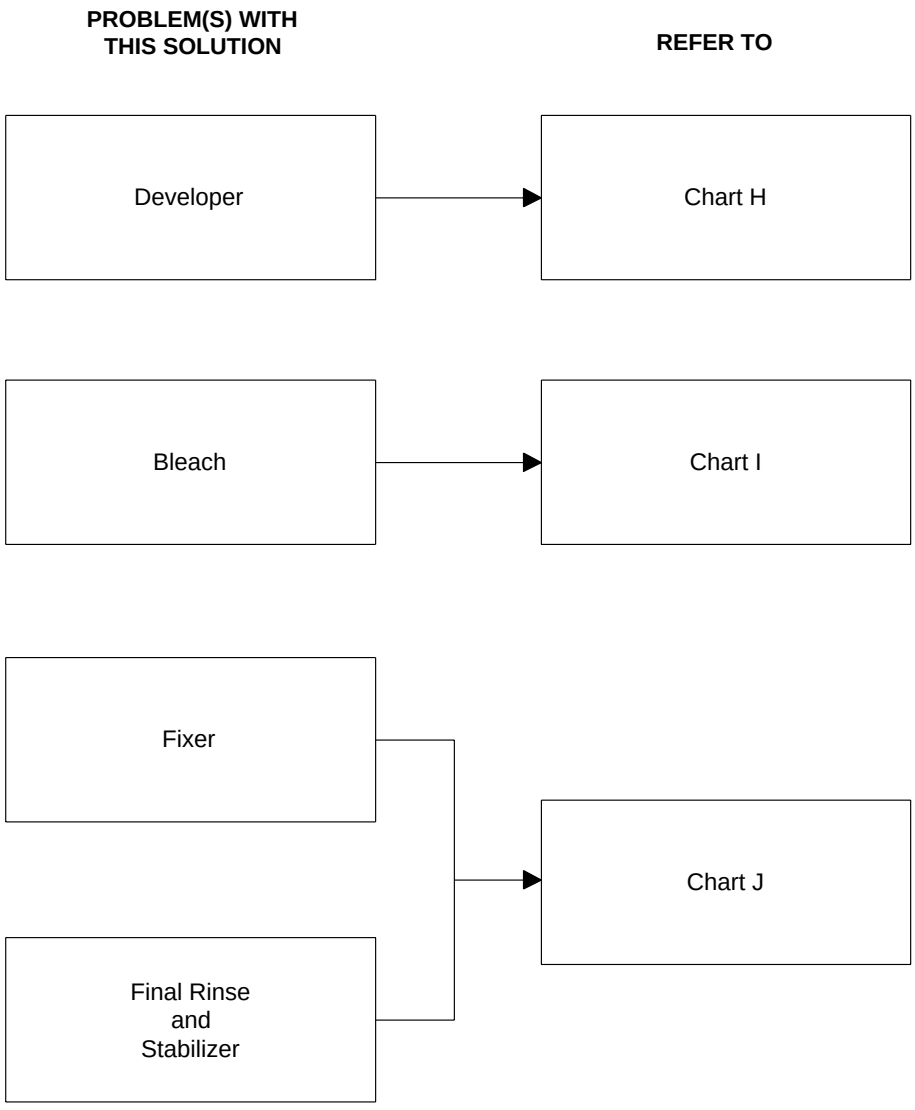


Chart G
Visual Appearance—Processing Solutions—Summary



F002_9051DC

Chart H
Visual Appearance—Developer

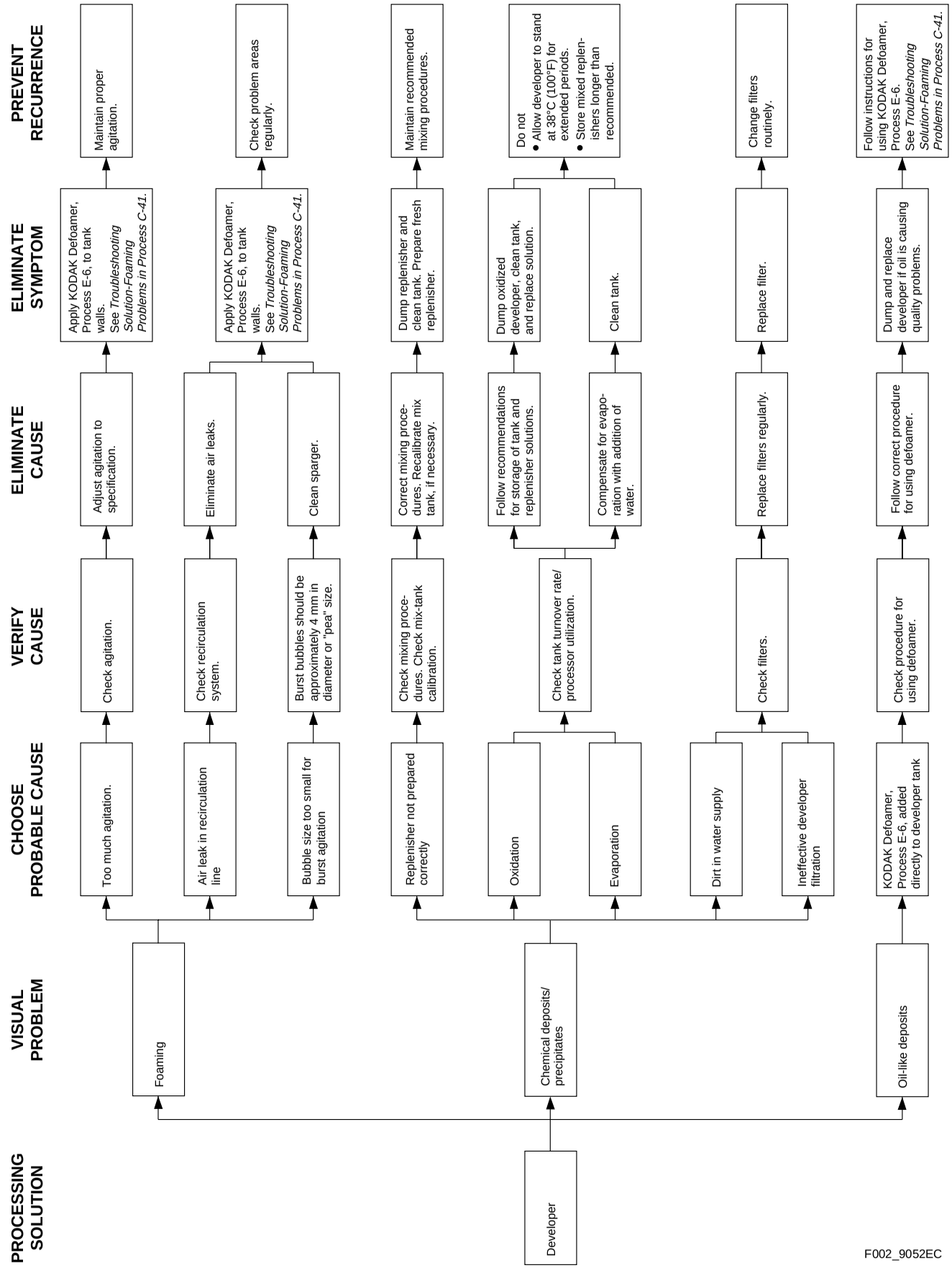


Chart I
Visual Appearance—Bleach

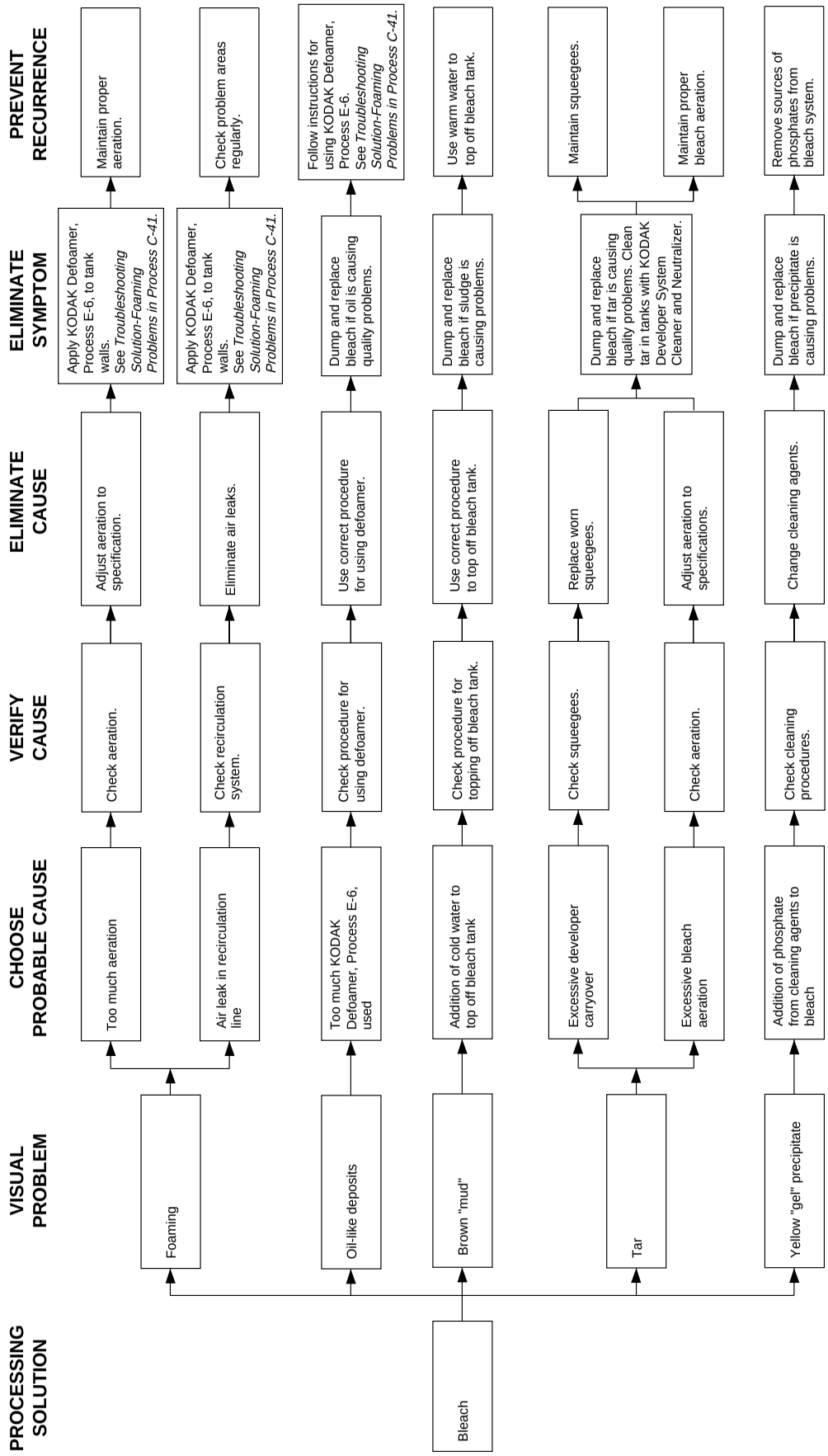


Chart J
Visual Appearance—Fixer, Stabilizer, and Final Rinse

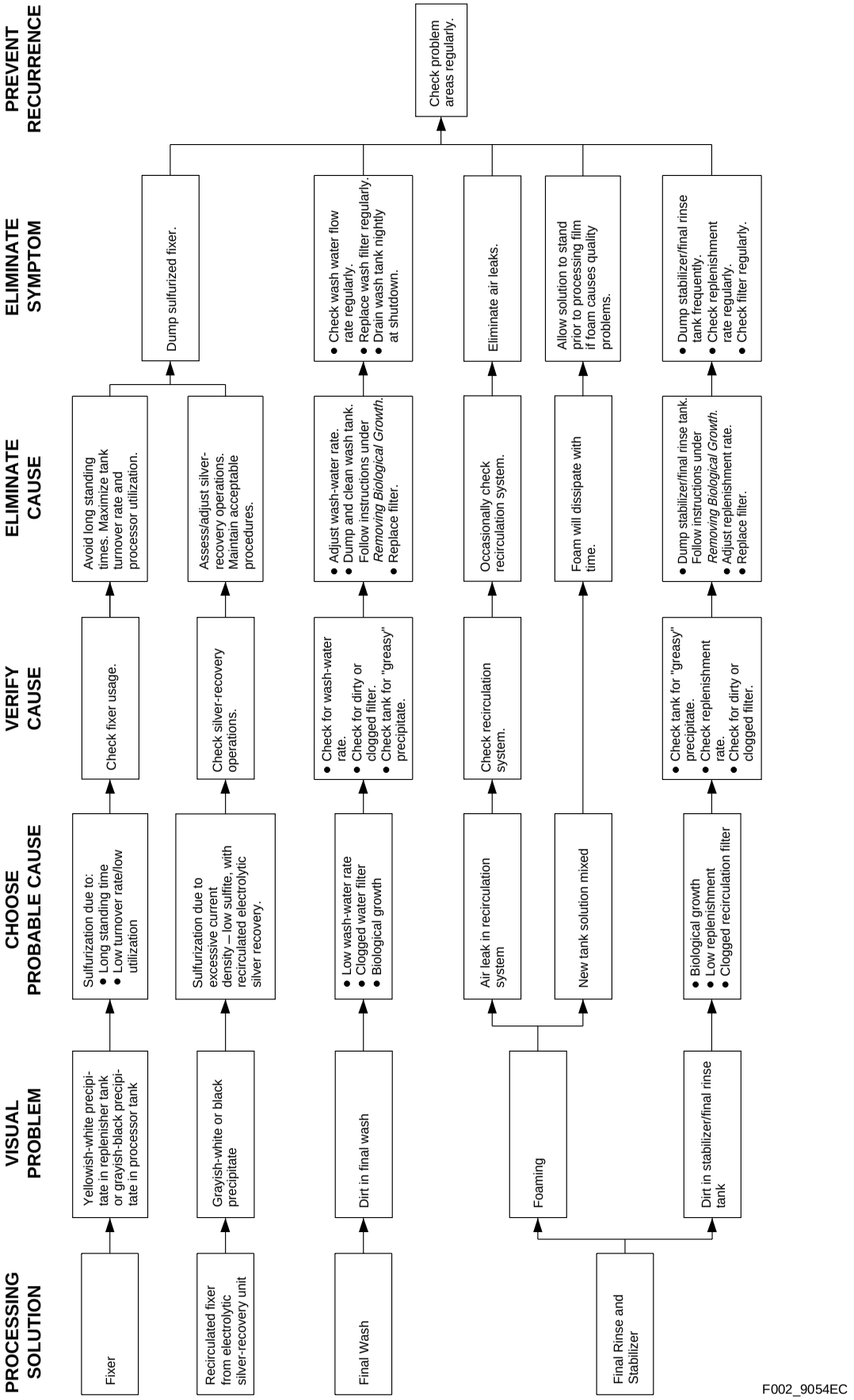
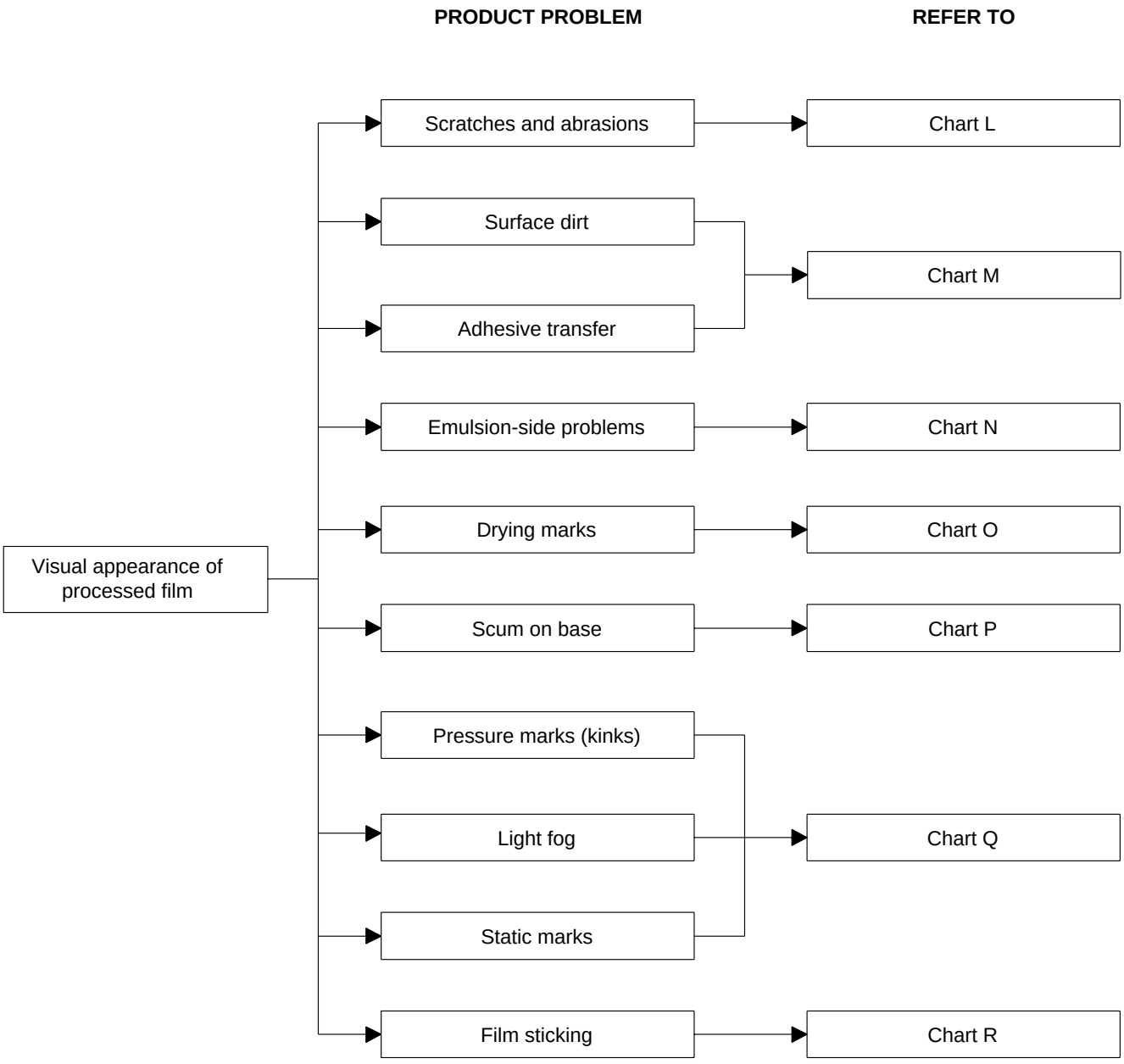


Chart K
Visual Appearance—Film—Summary



F002_9055EC

Chart L
Visual Appearance—Film—Scratches and Abrasions

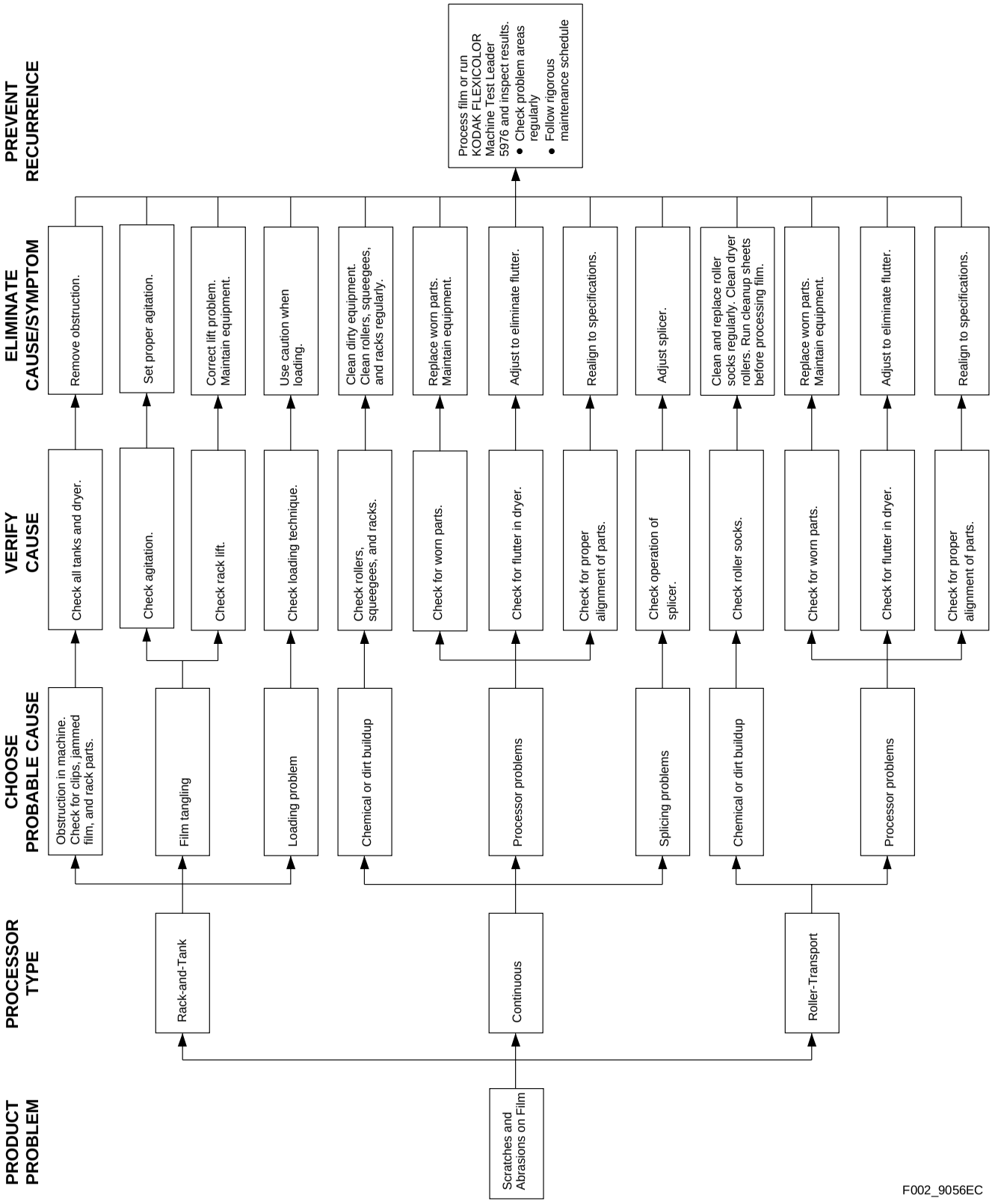


Chart M
Visual Appearance—Film—Surface Dirt and Adhesive Transfer

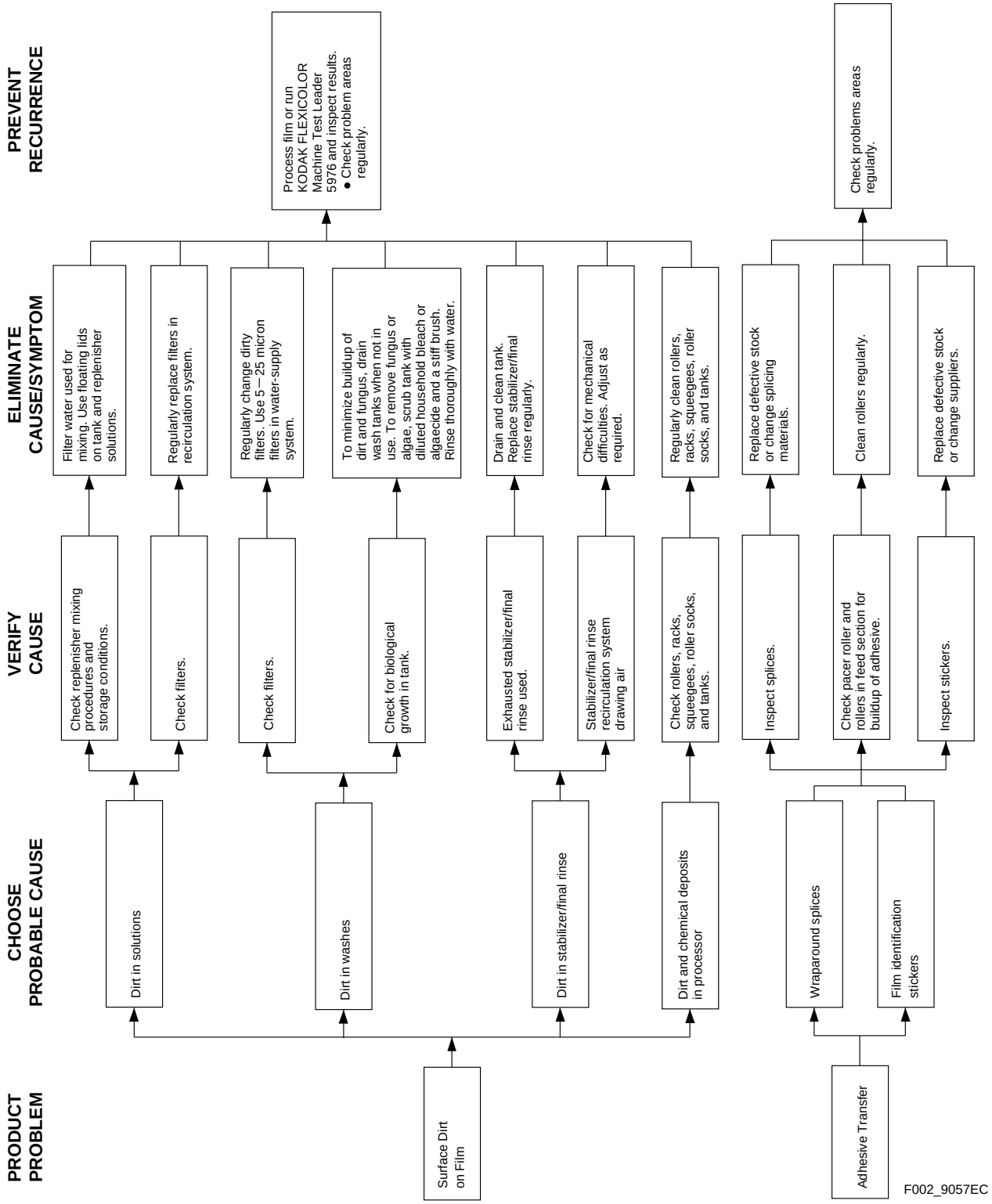


Chart N
Visual Appearance—Film—Emulsion-Side Problems

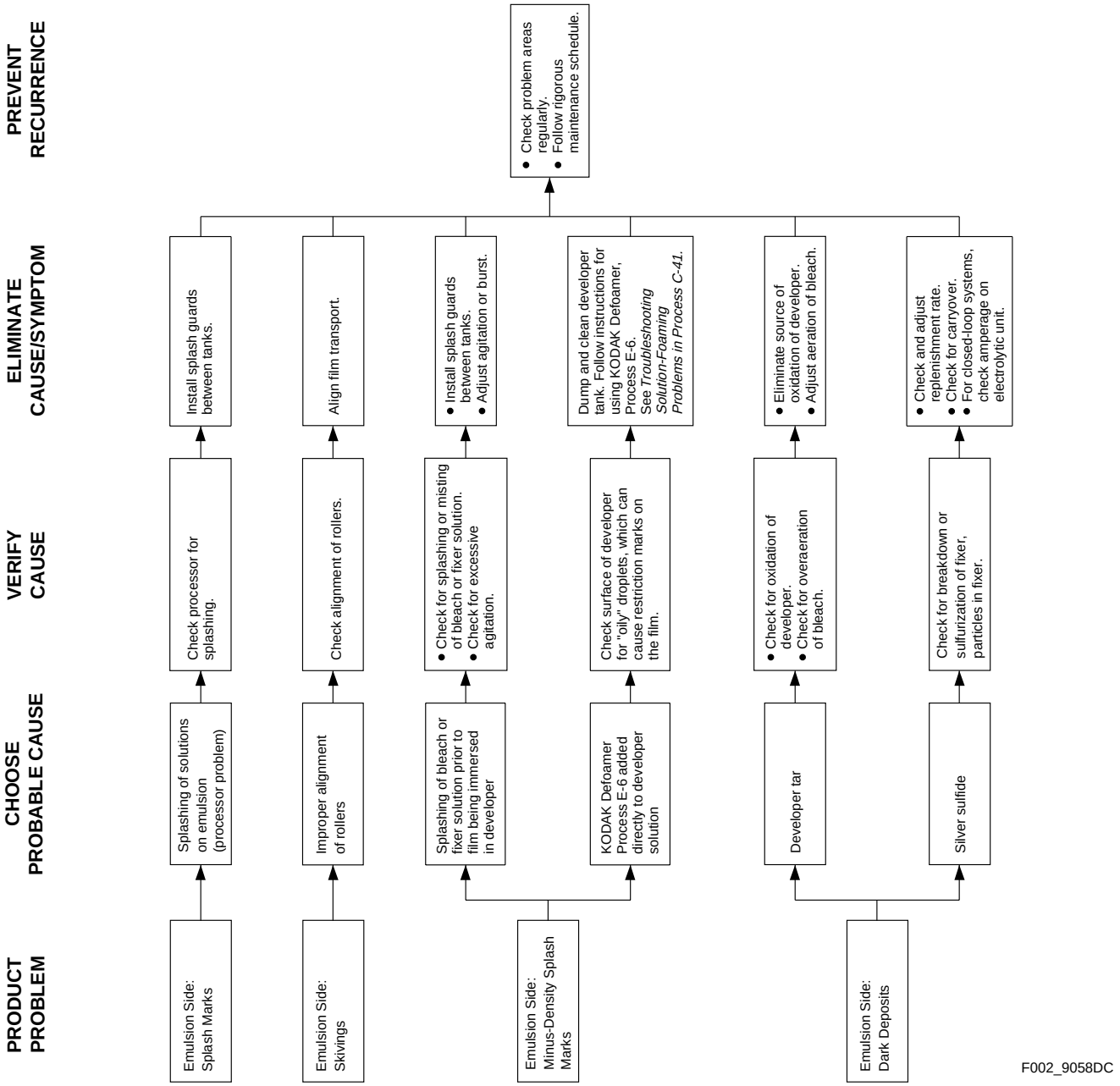
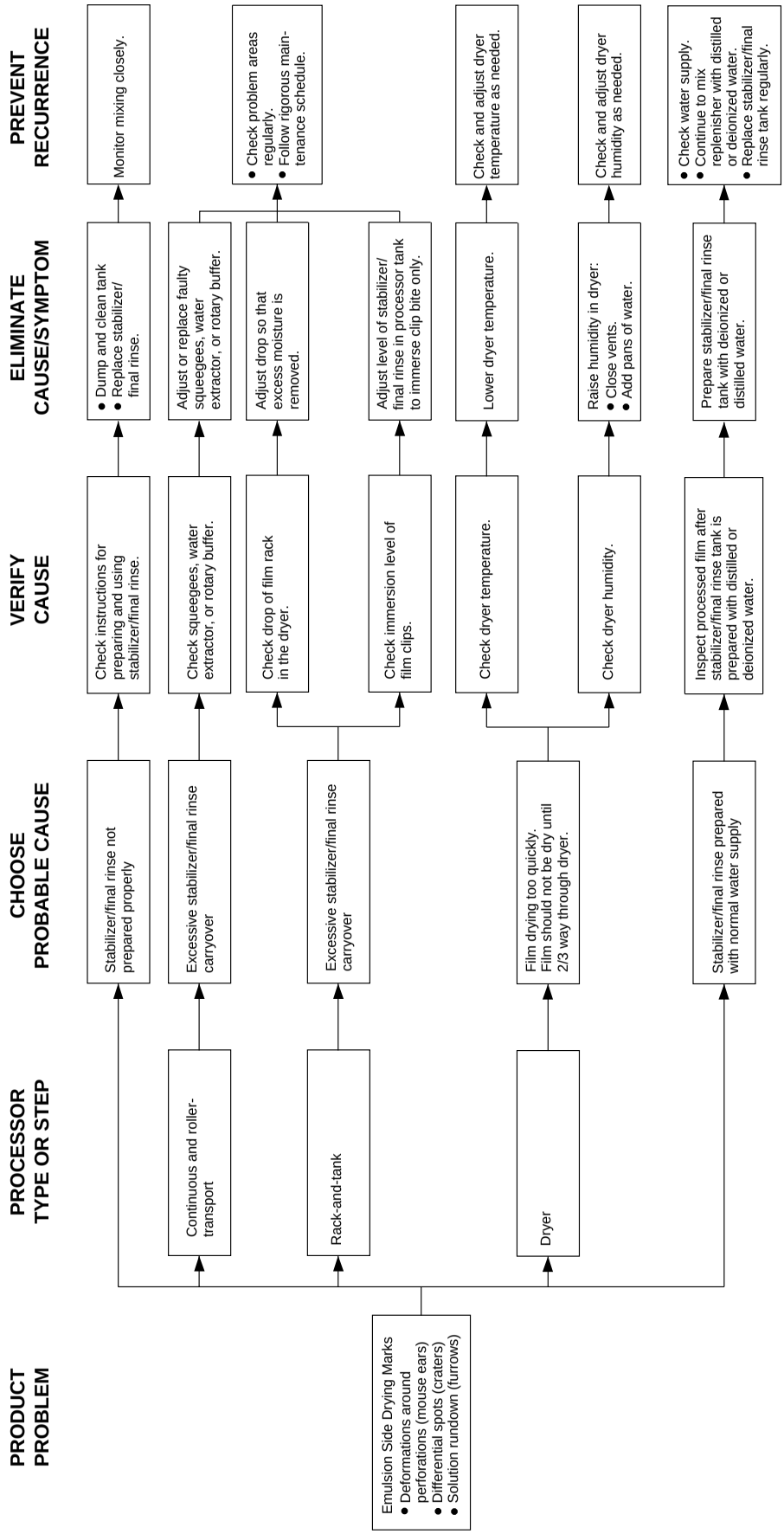


Chart O

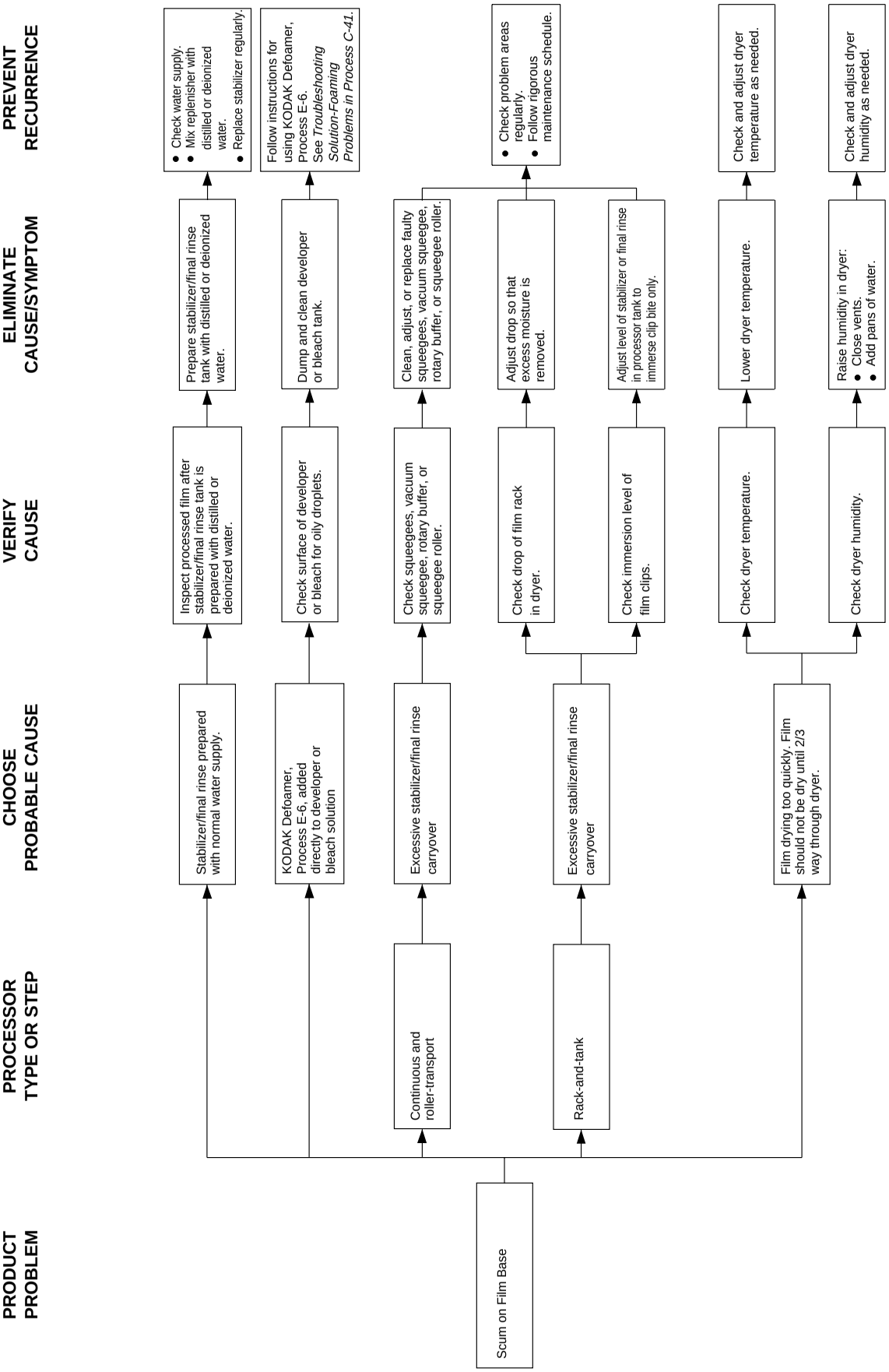
Visual Appearance—Film—Drying Marks



Note: Check probable causes on this chart in order of appearance.

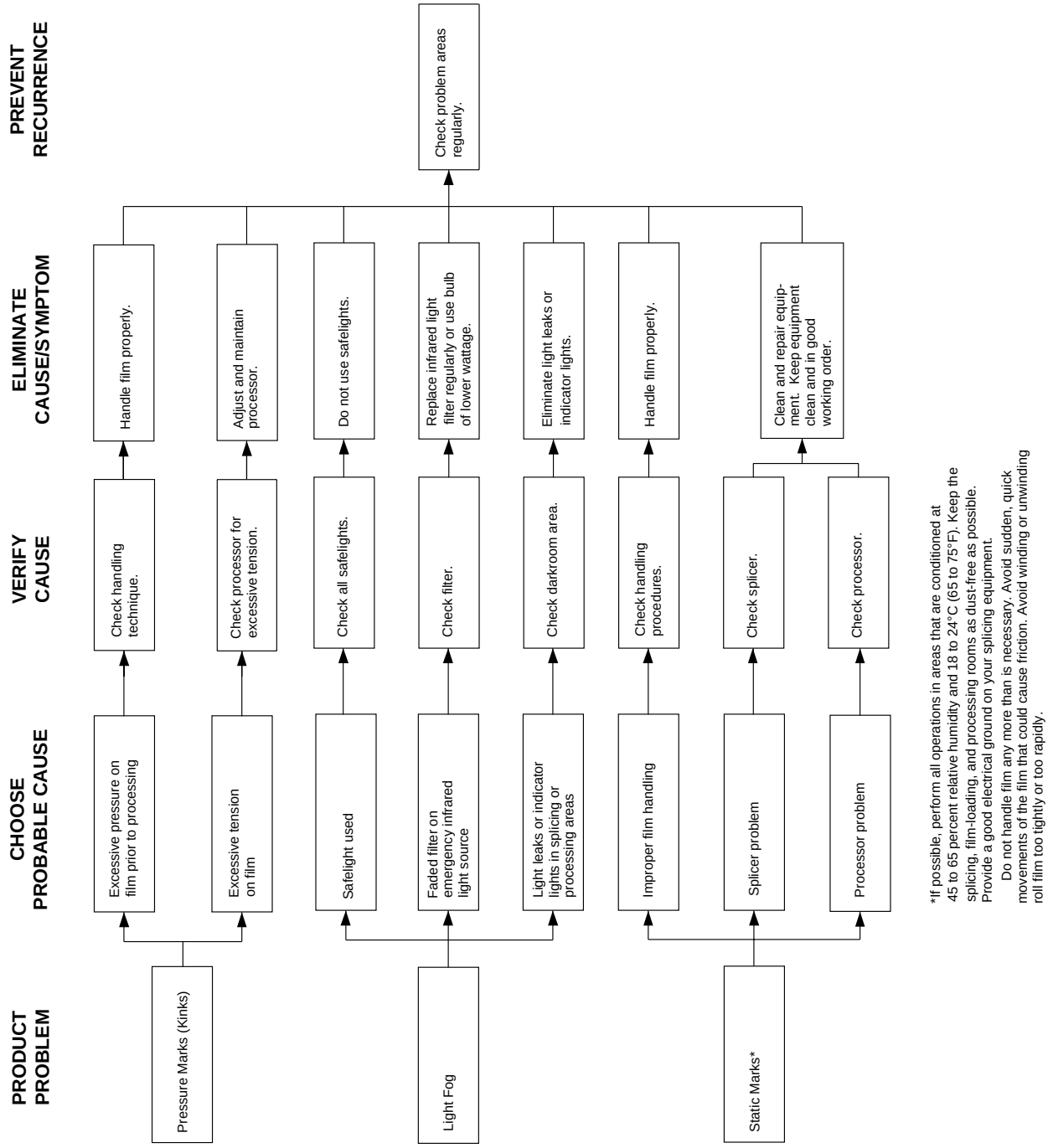
F002_9059EC

Chart P
Visual Appearance—Film—Scum



Note: To remove scum from the film, wash, repeat stabilizer/final rinse step, and dry, or clean the film.
Do not use FLEXICOLOR Stabilizer III in minilabs.

Chart Q
Visual Appearance—Film—Pressure Marks, Fog, Static

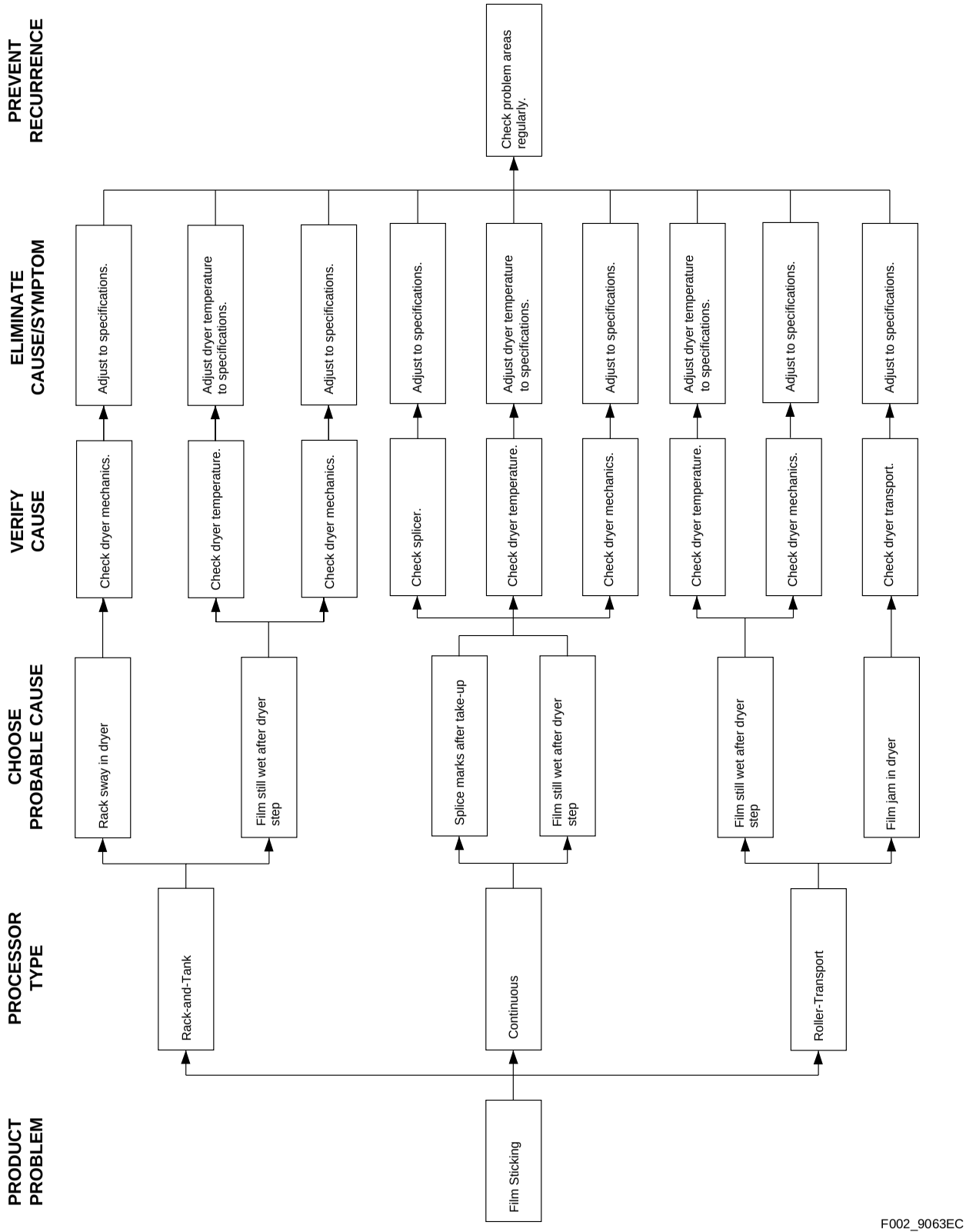


*If possible, perform all operations in areas that are conditioned at 45 to 65 percent relative humidity and 18 to 24°C (65 to 75°F). Keep the splicing, film-loading, and processing rooms as dust-free as possible. Provide a good electrical ground on your splicing equipment.

Do not handle film any more than is necessary. Avoid sudden, quick movements of the film that could cause friction. Avoid winding or unwinding roll film too tightly or too rapidly.

F002_9064EC

Chart R
Physical Appearance—Film—Sticking



Troubleshooting Solution-Foaming Problems in Process C-41

Foaming of process solutions can have an adverse effect on the quality of processed films, and can lead to solution contamination. If foaming is severe in any process solution, check the following:

1. Make sure that no air is being drawn into the tank solution through the recirculation system. Air drawn into the recirculation system produces very fine bubbles, which promote foaming and misting of solutions. Check for pinhole leaks in the line, a filter pod that is not sealed, or a loose fitting. With a rack-and-tank processor, make sure that the gaseous-burst agitation system is shut off when you check for these problems.
2. In rack-and-tank processors, make sure that the bubbles used for agitation are approximately 4 mm in diameter ("pea-sized" bubbles). Bubbles that are too small can promote foaming and misting of solutions. Small bubbles usually result from sparger holes that are too small or from holes that are restricted by chemical residue. To reduce the tendency for residue to build up in sparger holes in the developer tank, make sure to use humidified nitrogen of at least 99-percent purity.

   Note: When cleaning the burst sparger to remove residue, be careful not to enlarge the holes by using a tool that is too large. Enlarged holes will produce large bubbles that can cause solution splashing at the top of the tank.
3. In rack-and-tank processors, make sure that the pressure of the burst agitation causes a maximum solution rise of approximately 5/8 inch (1.5 cm). Too much pressure will make the solution rise excessively, creating more potential for solution foaming.
4. In rack-and-tank processors with small tanks, the developer tank has an increased tendency to foam when you use FLEXICOLOR Developer Replenisher LORR. Try switching to the standard FLEXICOLOR Developer Replenisher to reduce foaming (and be sure to increase the developer replenishment rate accordingly).

As a last resort to reduce solution foaming in Process C-41, use KODAK Defoamer, Process E-6 (CAT No. 125 3566) according to the following directions:

1. Use the defoamer sparingly. Use a clean cotton swab to apply a thin coating on only two sides of the tank. Apply the defoamer at least ½ inch to 1 inch above the maximum solution level. With a rack-and-tank processor, the maximum solution level is the highest solution level reached during a burst agitation cycle.

   Note: *The defoamer should not come into direct contact with the process solution*. If the defoamer enters the solution, it can cause "oily" deposits or process restriction marks on film.
2. At processor start-up each day, remove the old defoamer from the sides of the tank(s) with a clean damp cloth, and reapply defoamer as in described in step 1.

CONTROL-CHART EXAMPLES

The following charts are examples of how various conditions will affect your control plots. They are intended *only as a guide;* your plots may not look exactly like these examples. Your plots may be different because of processor and control-strip differences and your processing conditions. More than one problem may also be affecting your process.

These plots are typical for a particular problem; however, if they do not exactly match your plots, find the one that most closely matches the predominant trend. Use these charts, along with the diagnostic charts and the information under *Interpreting Your Control Plot* to analyze process problems.

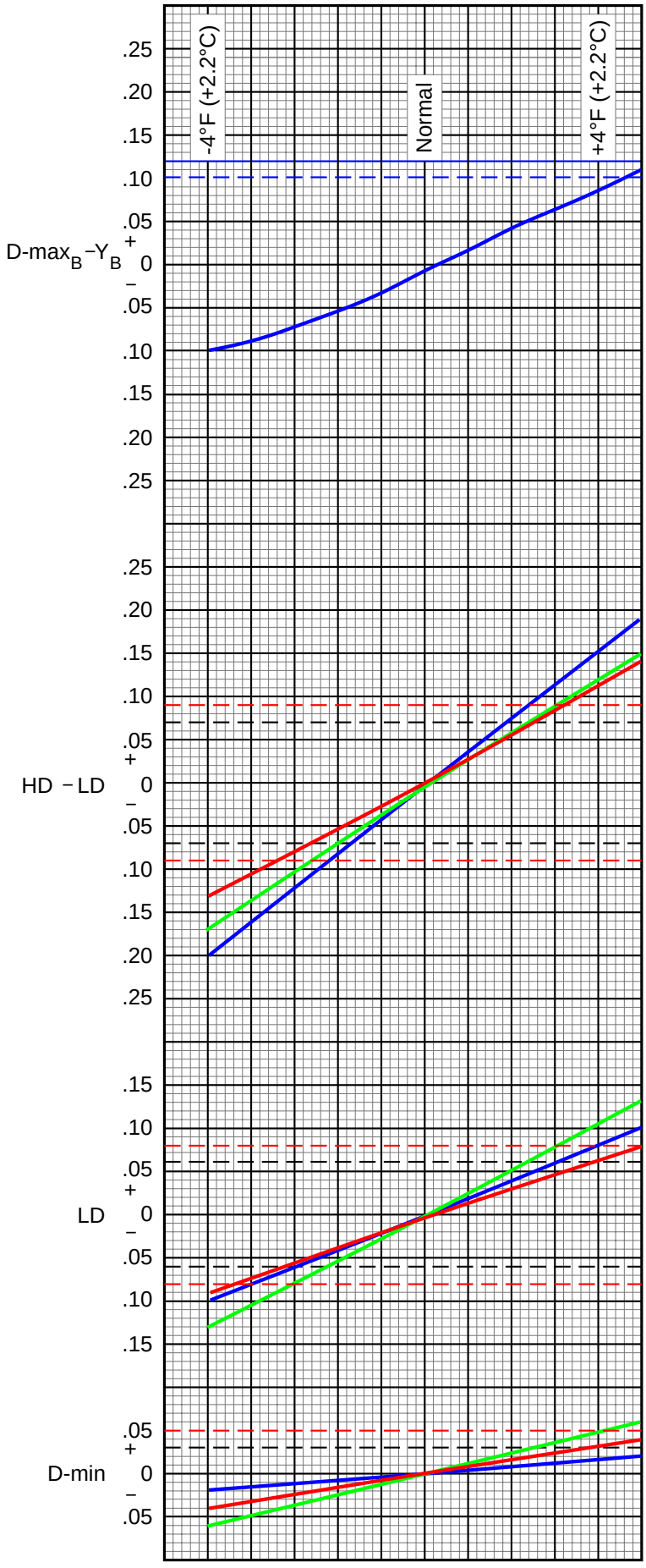
Chart	Solution	Condition
1	Developer	Temperature Too Low/High
2	Developer	Time Too Short/Long
3	Developer	Agitation Too Low/High
4	Developer Replenisher LORR	Replenishment Rate Too Low/High
5	Developer Replenisher	Replenishment Rate Too Low/High
6	Developer	Mix Error—Too Little/Much Part A
7	Developer	Mix Error—Too Little/Much Part B
8	Developer	Mix Error—Too Little/Much Part C
9	Developer Starter LORR	Fresh-Tank Mix Error—Too Little/Much
10	Developer Starter	Fresh-Tank Mix Error—Too Little/Much
11	Developer	Tank Solution Concentration — Too Low/High
12	Developer	Oxidation
13	Developer	Contaminated with Bleach
14	Developer	Contaminated with Fixer
15	Bleach III	Too Dilute
16	Bleach III	Replenishment Rate Too Low
17	RA Bleach	Replenishment Rate Too Low/High
18	Bleach III	Poor Aeration
19	RA Bleach	Poor Aeration
20	Bleach	Stain
21	Fixer	Too Dilute
22	Fixer	pH Too Low

Developer—
Temperature Too Low/High

Developer activity varies directly with temperature. High temperatures will increase the amount of dye formed; low temperatures will decrease the amount of dye formed. Check the developer temperature daily with an accurate thermometer. Check your temperature control unit daily.

Out-of-control conditions due to temperature changes are difficult to solve. They can appear and disappear rapidly because they are usually caused by intermittent electrical or tempered-water-flow problems. Poor tank recirculation can also cause temperature problems; insufficient dye will form when the temperature is not maintained uniformly throughout the tank. Check the developer temperature with an accurate thermometer if your temperature-control unit indicates fluctuations.

Chart 1



Developer—
Time Too Short/Long

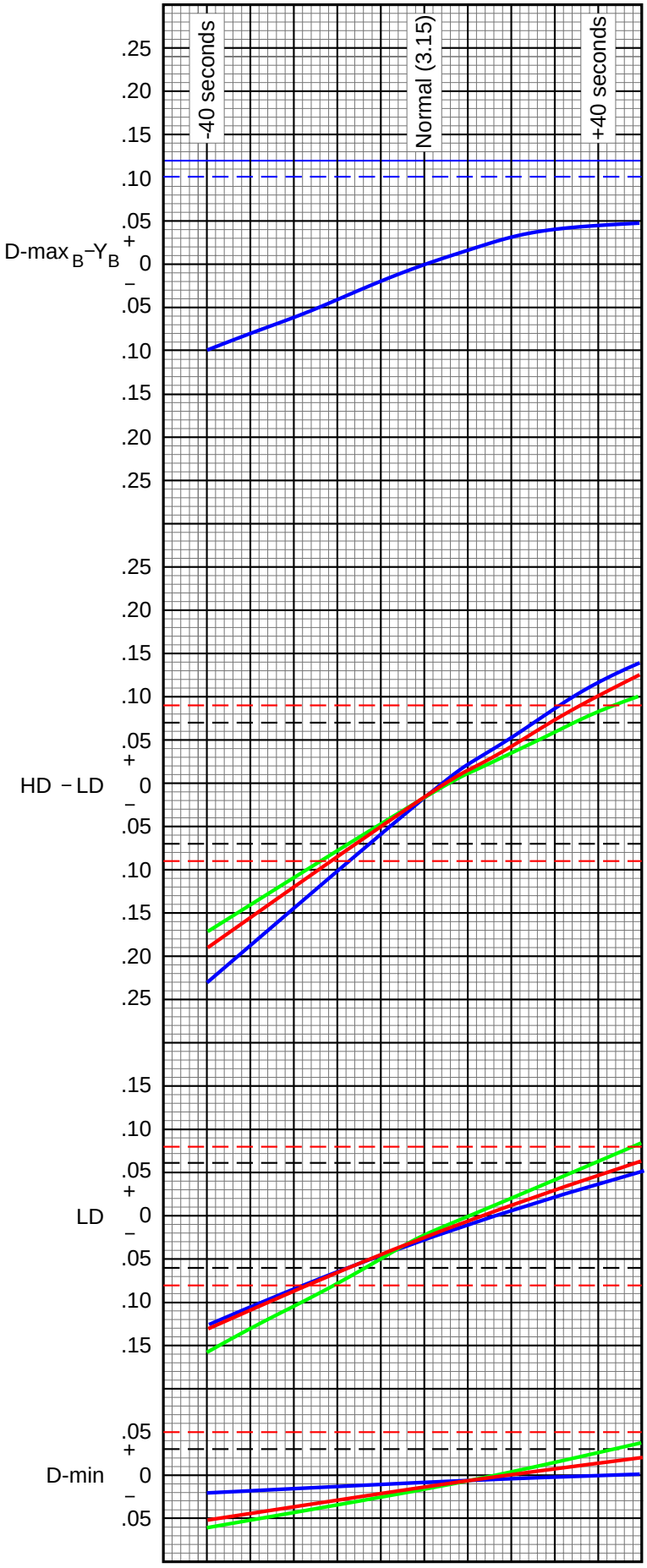
Developer activity varies directly with time. An increase in developer time produces an increase in the amount of dye formed; a decrease in developer time produces a decrease in the amount of dye formed.

Developer time variations can occur in processors because of electrical-load variations and motor-temperature differences from a cold start to normal operation. Electrical-load differences can be caused by other equipment, such as a heater on the same power line. In some cases, you may need a voltage regulator on the 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. Use a stopwatch to measure the developer time, and compare it with the machine setting.

Developer-time problems occur in manual processes in sink lines, small tanks, or rotary-tube processors because of operator error. Minimize errors by establishing reproducible techniques. Watch the timer closely, and make sure to allow the recommended drain time as part of the developer time.

Chart 2



Developer—
Agitation Too Low/High

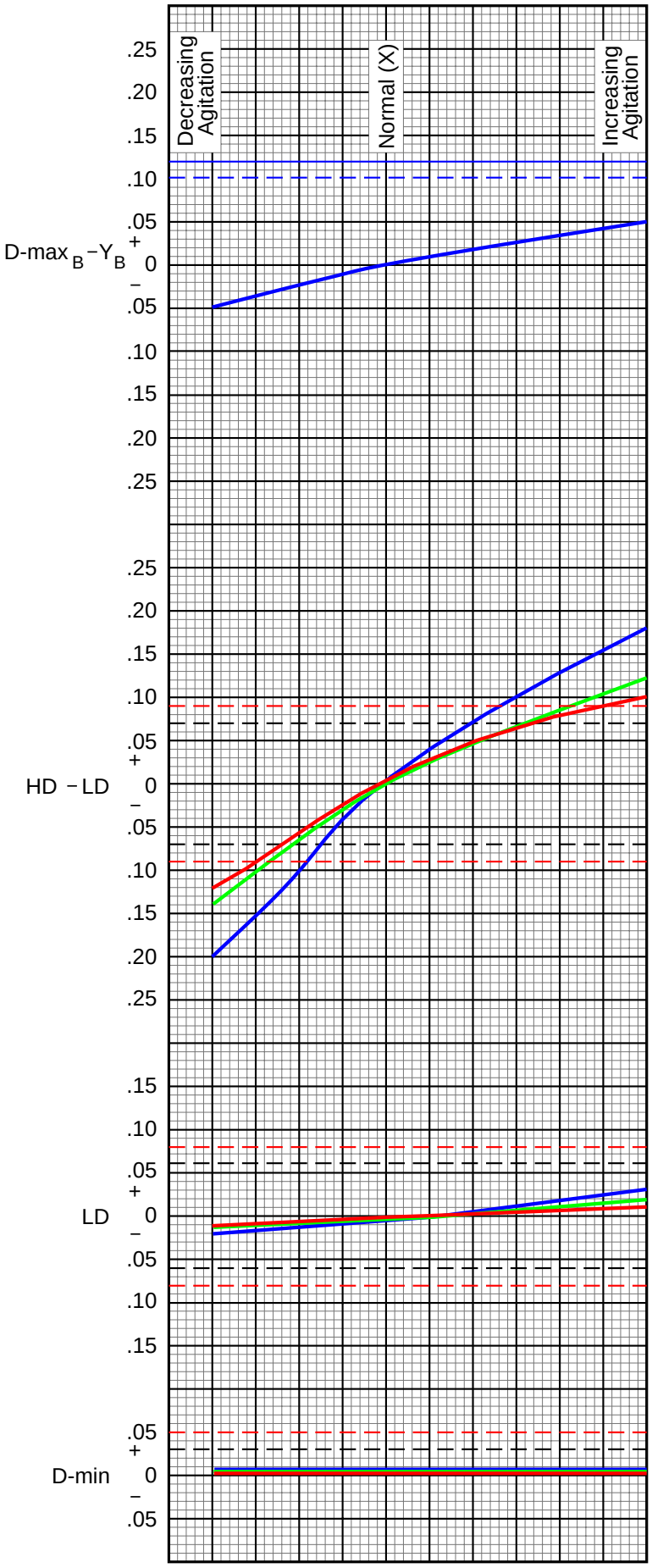
Agitation aids in removing developer by-products from the film so that fresh developer can diffuse into the emulsion. An increase in agitation increases the amount of dye formed. Poor agitation does not allow enough development, resulting in low and non-uniform densities. Fluctuations in agitation have the greatest effect on high densities.

Agitation is more likely to be a problem in manual processes such as sink lines, small tanks, and rotary-tube processors. To minimize agitation problems in manual processes, follow all recommendations carefully.

In rack-and-tank processors, developer agitation is provided by bursts of nitrogen or a recirculation system. Agitation must be sufficient and uniform to provide even development. A kinked recirculation line or plugged sparger can hinder agitation, causing underdevelopment. If agitation is excessive, oxidation and foaming in the developer will occur. For nitrogen-burst agitation, we recommend a 10-second cycle that consists of one 2-second burst followed by an 8-second rest. Use enough pressure to raise the solution level 1.5 cm (5/8 in.). The pressure should provide vigorous bursts that cover all areas of the tank in a uniform pattern without splashing. Check that your recirculation system is also operating properly.

In continuous processors, agitation is provided by a recirculation system. A kinked recirculation line or a plugged distributor bar can hinder agitation, causing underdevelopment. Also check the recirculation pumps to be sure they are working within specifications set by the manufacturers.

Chart 3



Developer Replenisher LORR—Replenishment Rate Too Low/High

Developer activity varies directly with the developer replenishment rate. An overreplenished developer will produce high dye densities; an underreplenished developer will produce low dye densities. You will see the effects of over- and underreplenishment in all of the control-plot densities.

How quickly your control plots indicate an incorrect replenishment rate depends on the tank volume, the machine speed, and the amount of film processed. Recheck the average film production that you use to calculate the replenishment rate. Check the flowmeter or pump setting manually as described in the processor manual; adjust it if necessary. See Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*, for starting-point developer replenishment rates. For minilabs, see Section 4, *Minilab Processors*.

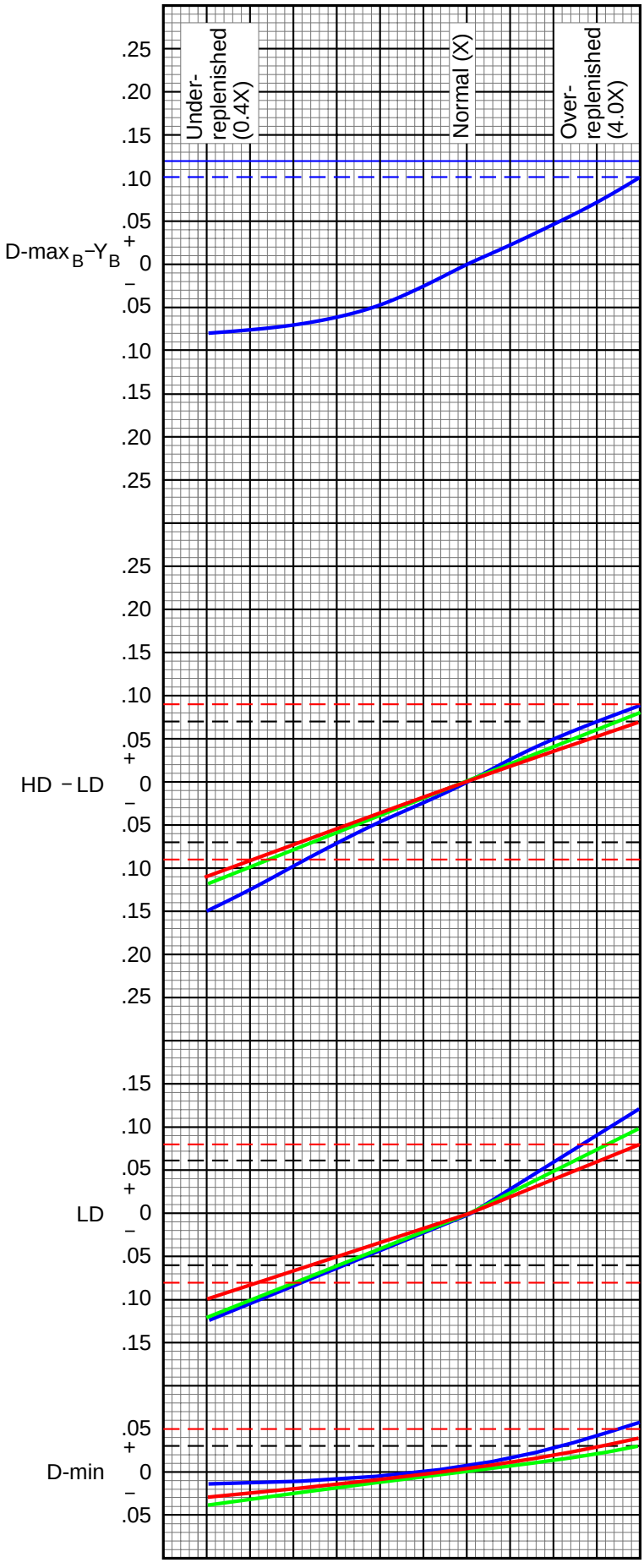
Developer replenishment rates supplied for each process are based on average exposures. Check your production; if it appears that the film has more or less density than usual, adjust your developer replenishment rate.

If overreplenishment is confirmed, adjust the developer tank solution by adding a solution of one part FLEXICOLOR Developer Starter LORR to four parts water. Add 25 mL of this mixture per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If high activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

If underreplenishment is confirmed, adjust the developer tank solution by adding 25 mL of a properly mixed developer replenisher LORR per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If low activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

Be sure that you do not add starter or replenisher solution close to the overflow, or you will lose the effect of the addition if it is lost to the overflow. Turn the recirculation on, and allow the developer to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition until the process plots within the control limits.

Chart 4



Developer Replenisher—Replenishment Rate Too Low/High

Developer activity varies directly with the developer replenishment rate. An overreplenished developer will produce high dye densities; and underreplenished developer will produce low dye densities. You will see the effects of over- and underreplenishment in all of the control-plot densities.

How quickly your control plots indicate an incorrect replenishment rate depends on the tank volume, the machine speed, and the amount of film processed. Recheck the average film production that you use to calculate the replenishment rate. Check the flowmeter or pump setting manually as described in the processor manual; adjust it if necessary. See Section 2, *Continuous, Roller-Transport, and Rack-and-Tank Processors*, for starting-point developer replenishment rates. For minilabs, see Section 4, *Minilab Processors*.

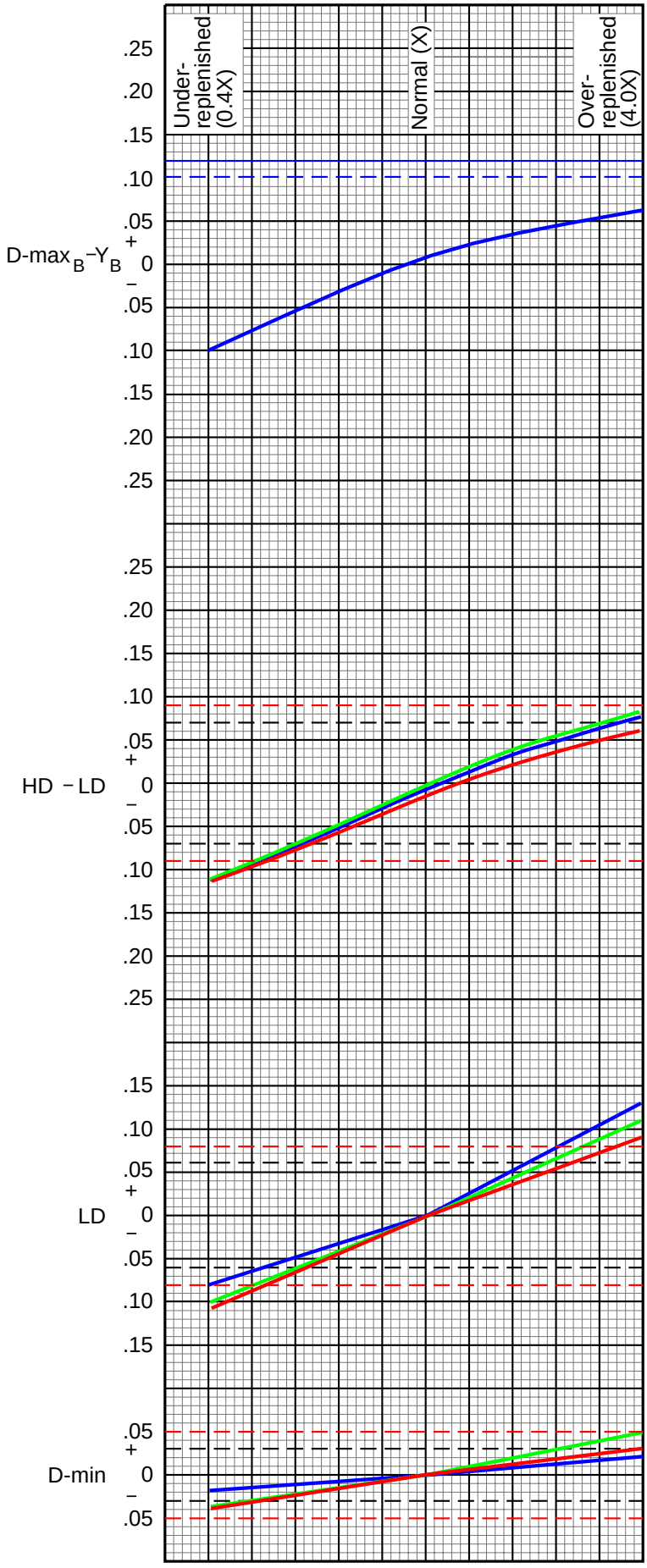
Developer replenishment rates supplied for each process are based on average exposures. Check your production; if it appears that the film has more or less density than usual, adjust your developer replenishment rate.

If overreplenishment is confirmed, adjust the developer tank solution by adding a solution of one part FLEXICOLOR Developer Starter to nine parts water. Add 25 mL of this mixture per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If high activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

If underreplenishment is confirmed, adjust the developer tank solution by adding 50 mL of a properly mixed developer replenisher per litre of developer tank solution. When you calculate the total tank volume, be sure to include tubing, tempering equipment, etc. If low activity was caused by an incorrectly mixed developer replenisher, replace the replenisher solution.

Be sure that you do not add starter or replenisher solution close to the overflow, or you will lose the effect of the addition. Turn the recirculation on, and allow the developer to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition until the process plots within the control limits.

Chart 5

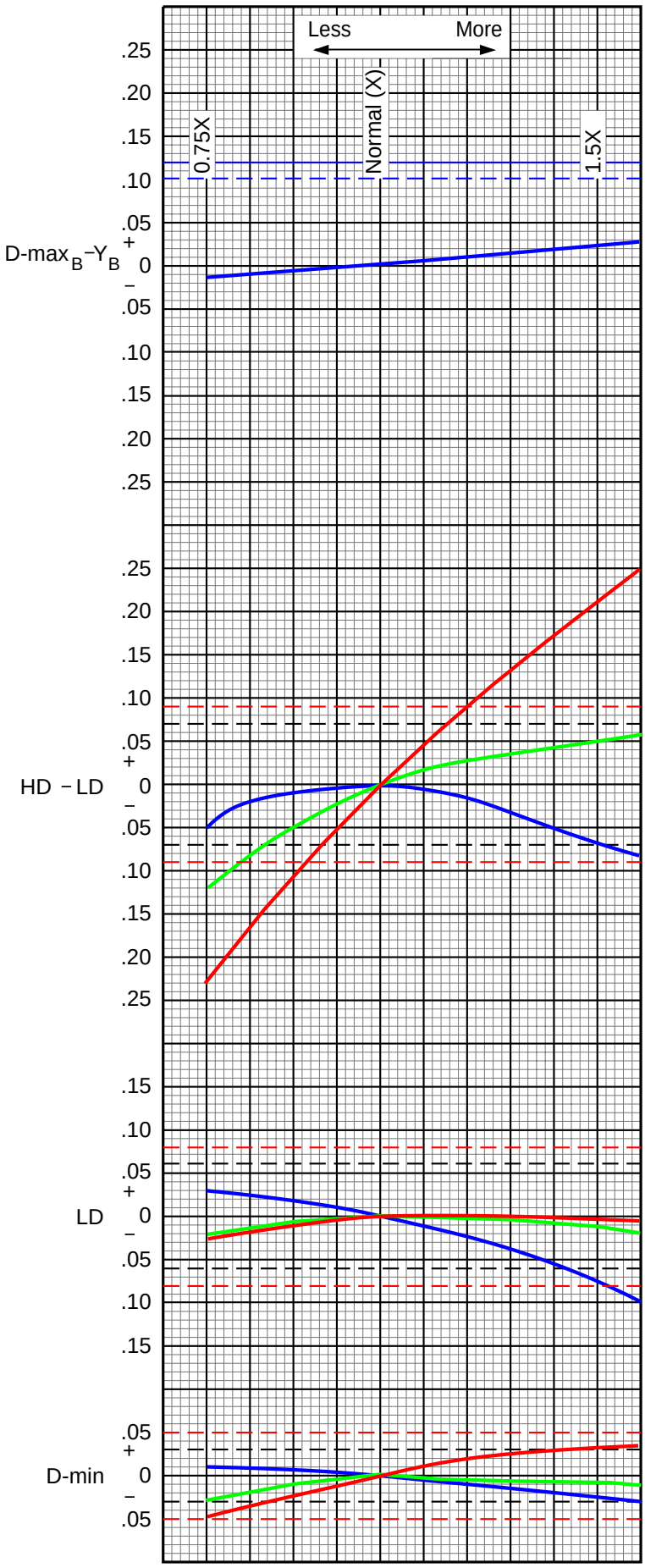


Developer—
Mix Error—Too Little/Much Part A

Using an incorrect amount of Part A to prepare developer tank solution has the greatest effect on the high red densities. In the HD – LD plot, the red density will increase dramatically when you use too much Part A; the red density plot will decrease if you do not use enough Part A. The green density will behave in a similar manner, but to a lesser degree. However, the blue density plot will decrease when you use too much or too little Part A.

Check your mixing procedures. Unless you know the incorrect amount of Part A used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

Chart 6

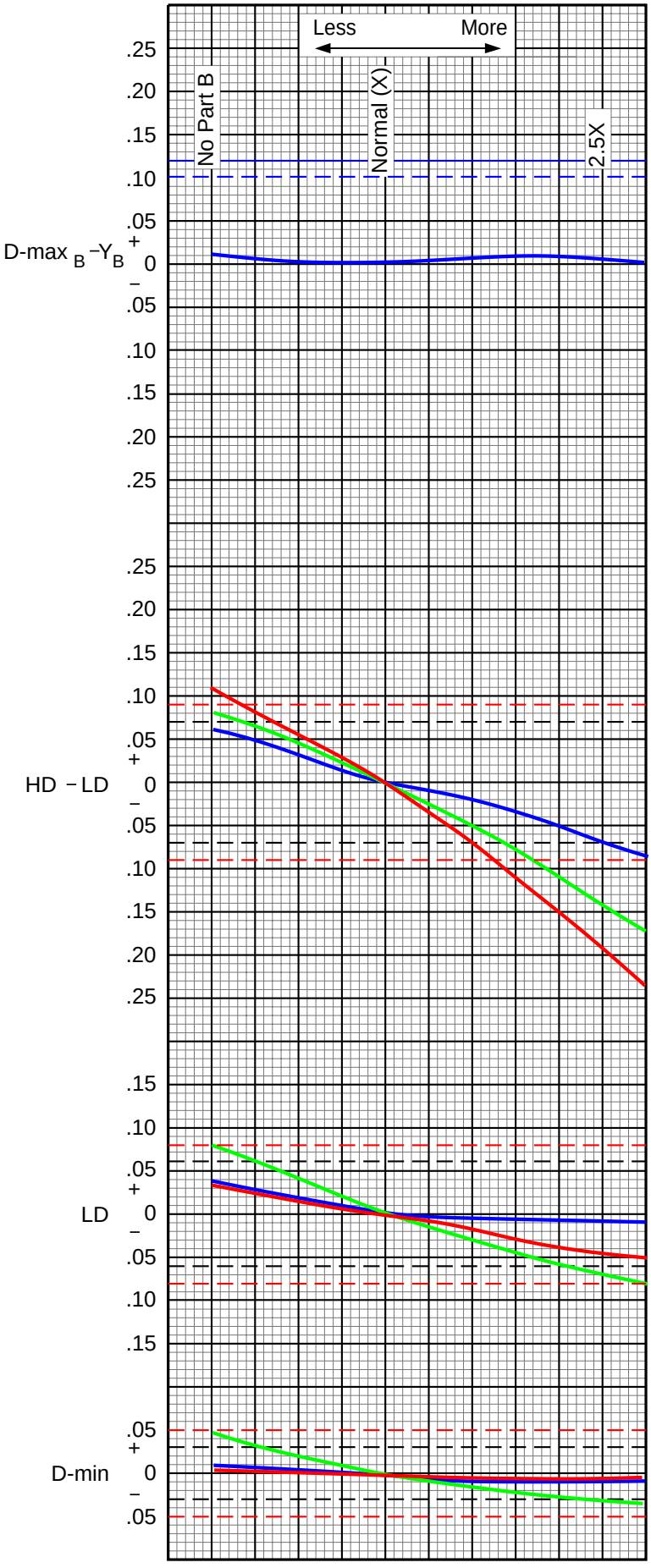


Developer—
Mix Error—Too Little/Much Part B

Developer activity varies inversely with the amount of Part B used to prepare developer tank solution. If the solution is prepared with too little Part B, developer activity will increase and more dye will form. If the solution is mixed with too much Part B, developer activity will decrease and less dye will form. The densities of the HD – LD plot will show the greatest effects of an incorrect amount of Part B.

Check your mixing procedures. Unless you know the incorrect amount of Part B used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

Chart 7



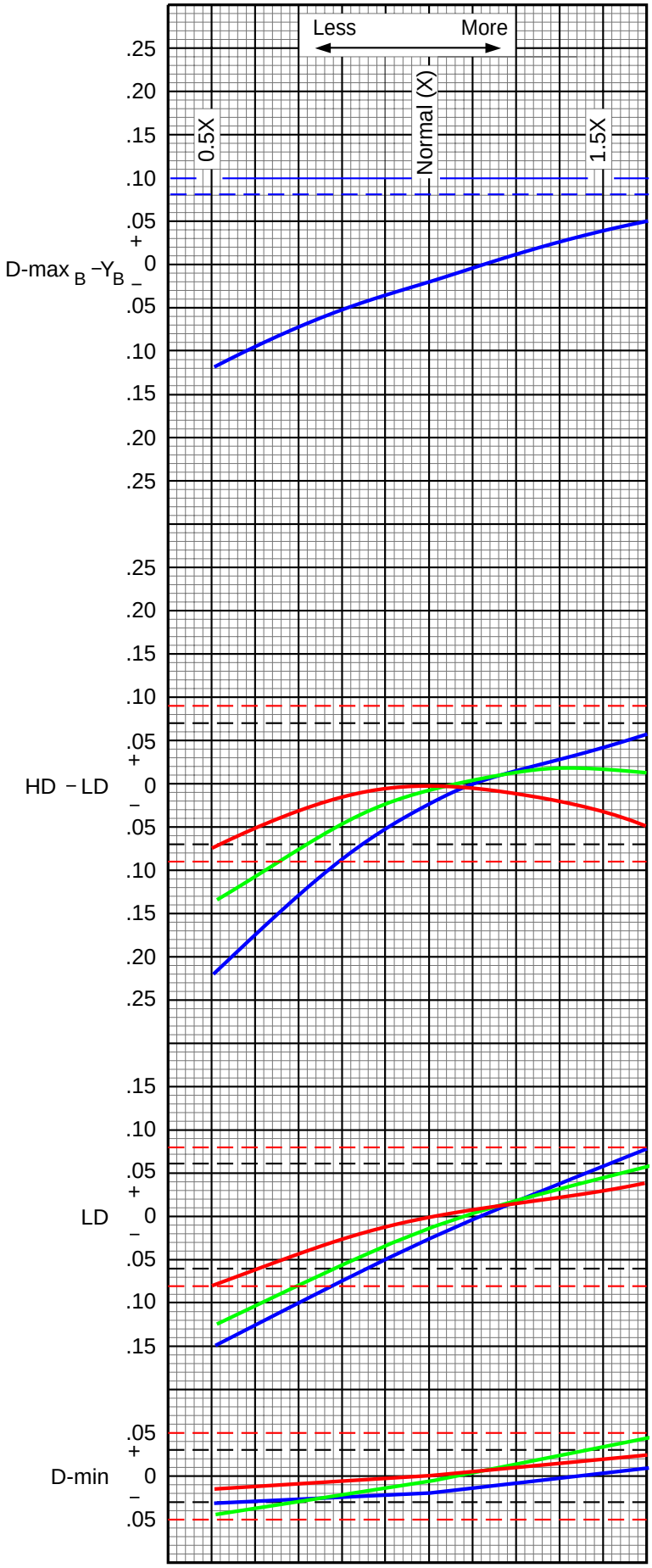
Developer—
Mix Error—Too Little/Much Part C

Developer activity varies directly with the amount of Part C used to prepare developer tank solution. If the solution is prepared with too little Part C, developer activity will decrease and less dye will form. If the solution is prepared with too much Part C, developer activity will increase and more dye will form.

The blue density of the HD – LD plot will show the greatest effects of an incorrect amount of Part C used. If an insufficient amount of Part C is used, the red, green, and blue HD – LD densities will be too low. If too much Part C is used, the green and blue densities will increase.

Check your mixing procedures. Unless you know the incorrect amount of Part C used, it is difficult to correct the mix without a chemical analysis; we recommend that you replace your developer solution.

Chart 8



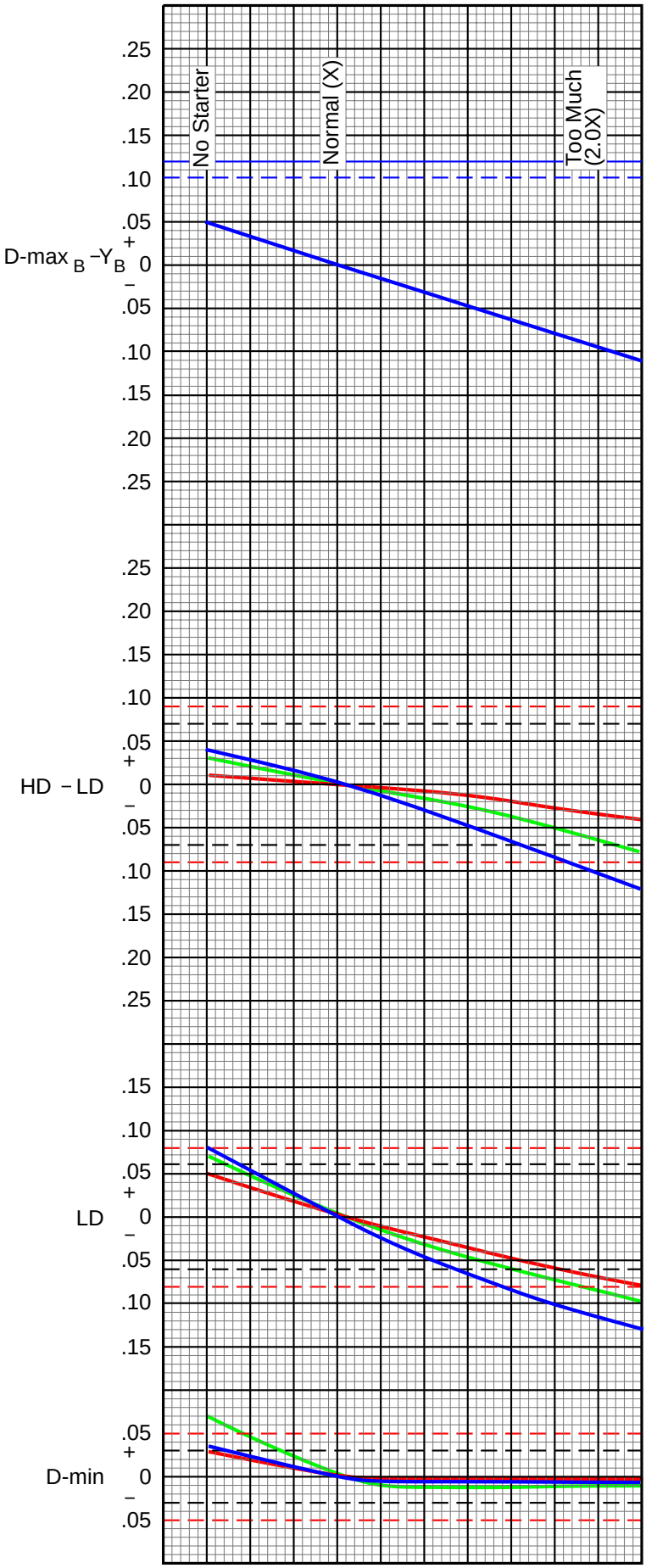
Developer Starter LORR—Fresh-Tank Mix Error—Too Little/Much

Developer activity varies inversely with the amount of developer starter used to prepare a fresh tank solution. Too much starter results in low dye formation; too little starter results in high dye formation.

If you know the problem is high developer activity caused by adding too little FLEXICOLOR Developer Starter LORR to fresh developer tank solution, add developer starter LORR to the tank solution in 11 mL/L increments until the control-plot densities indicate that the process is within control limits. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip.

If you know the problem is low developer activity caused by adding too much FLEXICOLOR Developer Starter LORR to the developer tank solution, add 39 mL of developer replenisher LORR and 13 mL of water per litre of developer tank solution. Be sure that you do not add the solution close to the overflow or you will lose the effect of the addition. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition if necessary.

Chart 9



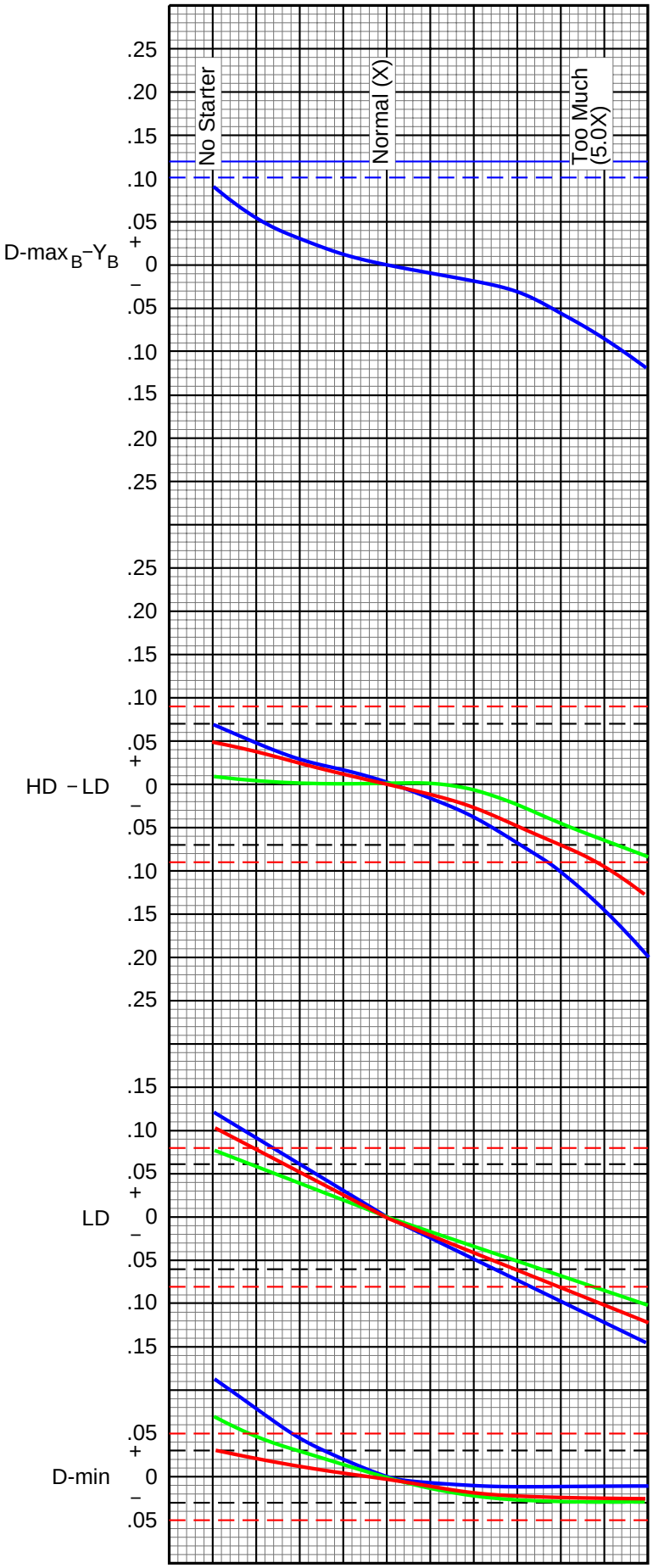
Developer Starter—Fresh-Tank Mix Error—Too Little/Much

Developer activity varies inversely with the amount of developer starter used to prepare a fresh tank solution. Too much starter results in low dye formation; too little starter results in high dye formation.

If you know the problem is high developer activity caused by adding too little FLEXICOLOR Developer Starter to fresh developer tank solution, add developer starter to the tank solution in 5.5 mL/L increments until the control-plot densities indicate that the process is within control limits. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip.

If you know the problem is low developer activity caused by adding too much FLEXICOLOR Developer Starter to the developer tank solution, add 43.6 mL of developer replenisher and 6.4 mL of water per litre of developer tank solution. Be sure that you do not add the solution close to the overflow, or you will lose the effect of the addition. Turn the recirculation on, and allow the starter to mix for at least 15 minutes before you run a control strip. Make sure your process is up to temperature before you run a control strip. Repeat the addition if necessary.

Chart 10



Developer—
Tank Solution Concentration—
Too Low/High

When you prepare a fresh developer tank solution, the amount of water you use affects the developer concentration. If you use too much water, the developer will be diluted and dye density will be low. If you do not use enough water, the developer will be overconcentrated and dye density will be high.

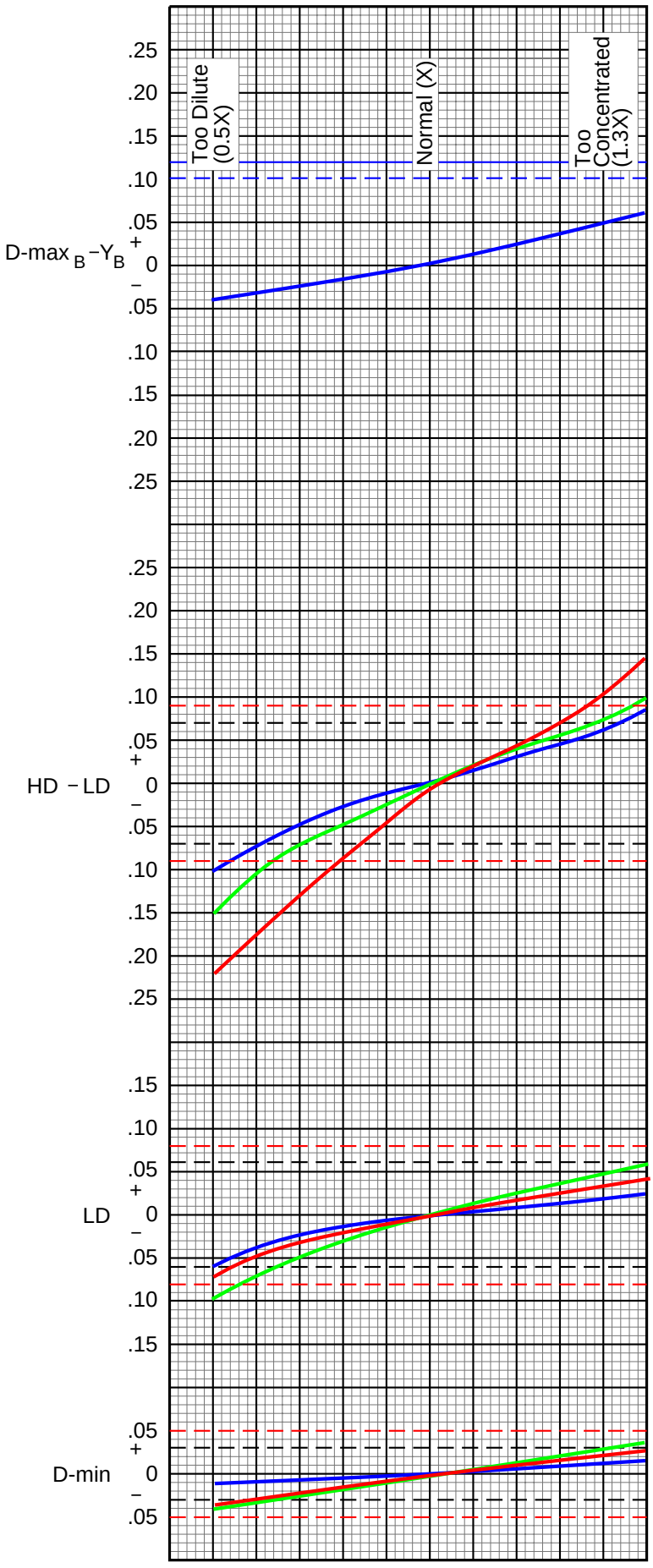
If you know that your process is out of control because the developer tank solution is diluted, replace the tank solution.

If your control plot indicates that the tank solution is overconcentrated, you can add water to the developer tank to bring the plots within tolerance. However, unless you know the amount of water that was omitted, **do not** add more than 5 percent of the total tank volume to correct the concentration.

In seasoned tank solutions, evaporation causes increased developer concentration and dye density. This is especially true in low-utilization operations. Be sure to top off your tank solution with water daily at start-up.

You can monitor the concentration of your developer tank solution by making specific-gravity measurements with a hydrometer (see *Check Your Mixes with Specific-Gravity Measurements* in Section 1, *KODAK FLEXICOLOR Chemicals*).

Chart 11



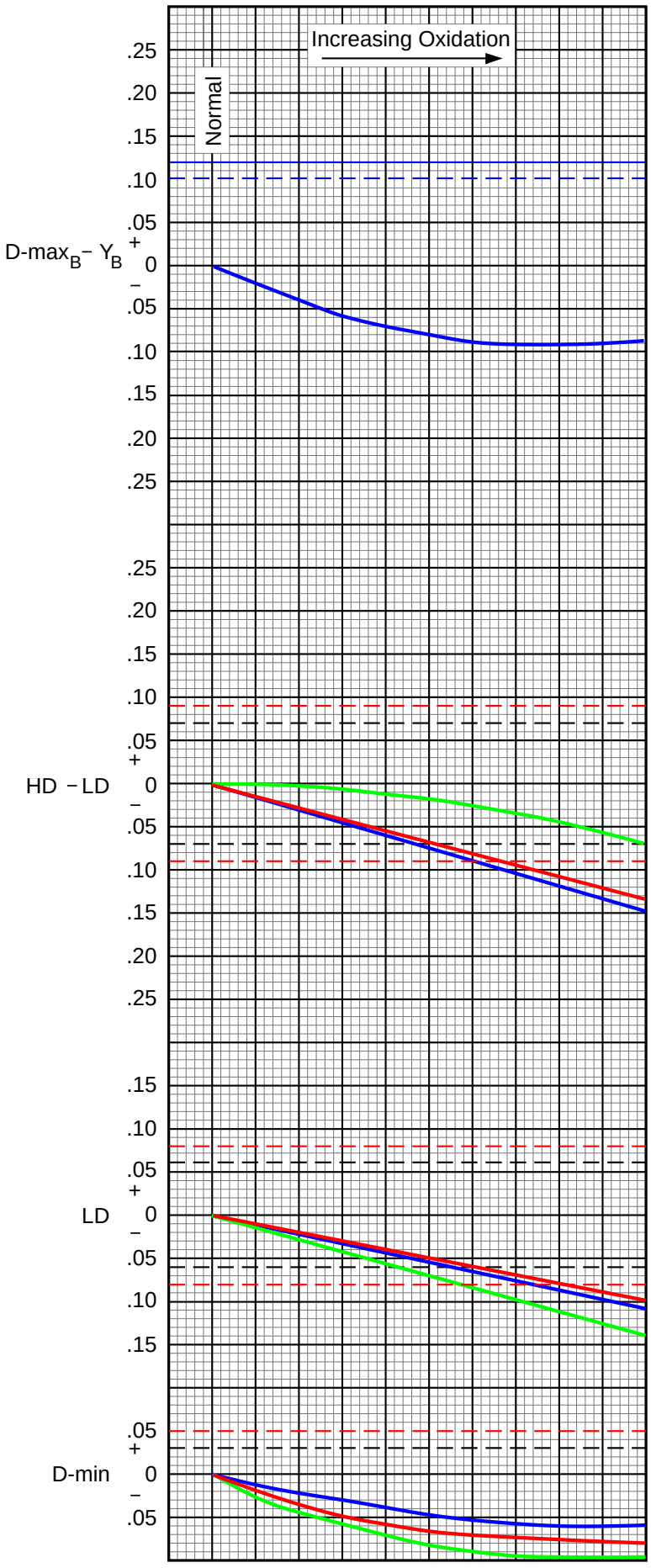
Developer—Oxidation

Developer activity can be affected by oxidation of the solution. Increasing developer oxidation causes less dye to form, lowering density values.

Use floating lids on all developer replenisher tanks. By protecting the developer replenisher from contact with air, you can avoid problems caused by aerial oxidation. Oxidation will occur during idle periods when the processor is up to temperature but is not processing film. This problem will be most noticeable in roller-transport and minilab processors with low utilization. You should be able to avoid severe oxidation problems in most processors by ensuring that at least one developer tank turnover occurs every 4 weeks.

Leaks in a recirculation line or fitting will allow air to bubble into the tank solution, causing oxidation. Check your equipment for leaks if oxidation occurs. Excessive gaseous-burst agitation in rack-and-tank processors can also oxidize the developer.

Chart 12



Developer—Contaminated with Bleach

Very small amounts of bleach will contaminate the developer and affect developer activity. The D-min and LD densities will increase because more dye forms due to chemical "fogging." The HD – LD plots will decrease with more contamination.

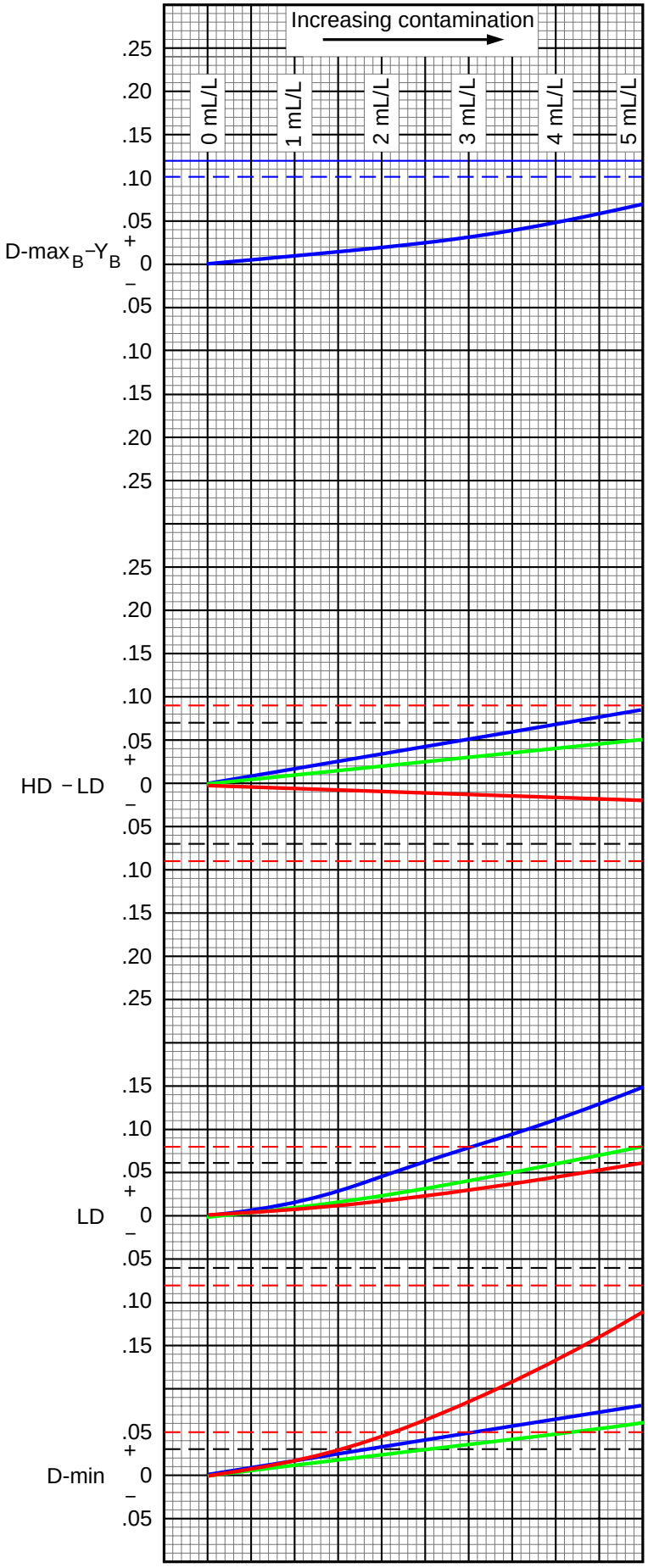
Use different mixing tanks when you prepare developer and bleach replenisher solutions. If bleach aeration is excessive, misting or splashing of the bleach can occur and slowly contaminate the developer tank.

In minilab processors, bleach can splash back into the developer as the leader card and film emerge from the bleach. The developer can also be contaminated by bleach complexes that have deposited onto the leader card. Clean all leader cards thoroughly each day at shutdown; you may need to soak them in hot water to remove the bleach. Replace worn or damaged leader cards.

Make sure that bleach does not drip into the developer when you remove the bleach racks for cleaning, maintenance, etc.

If bleach contamination occurs, stop processing customer film. After you locate and eliminate the source of contamination, dump the developer tank solution, rinse the tank thoroughly, and mix a fresh developer tank solution.

Chart 13



Developer—Contaminated with Fixer

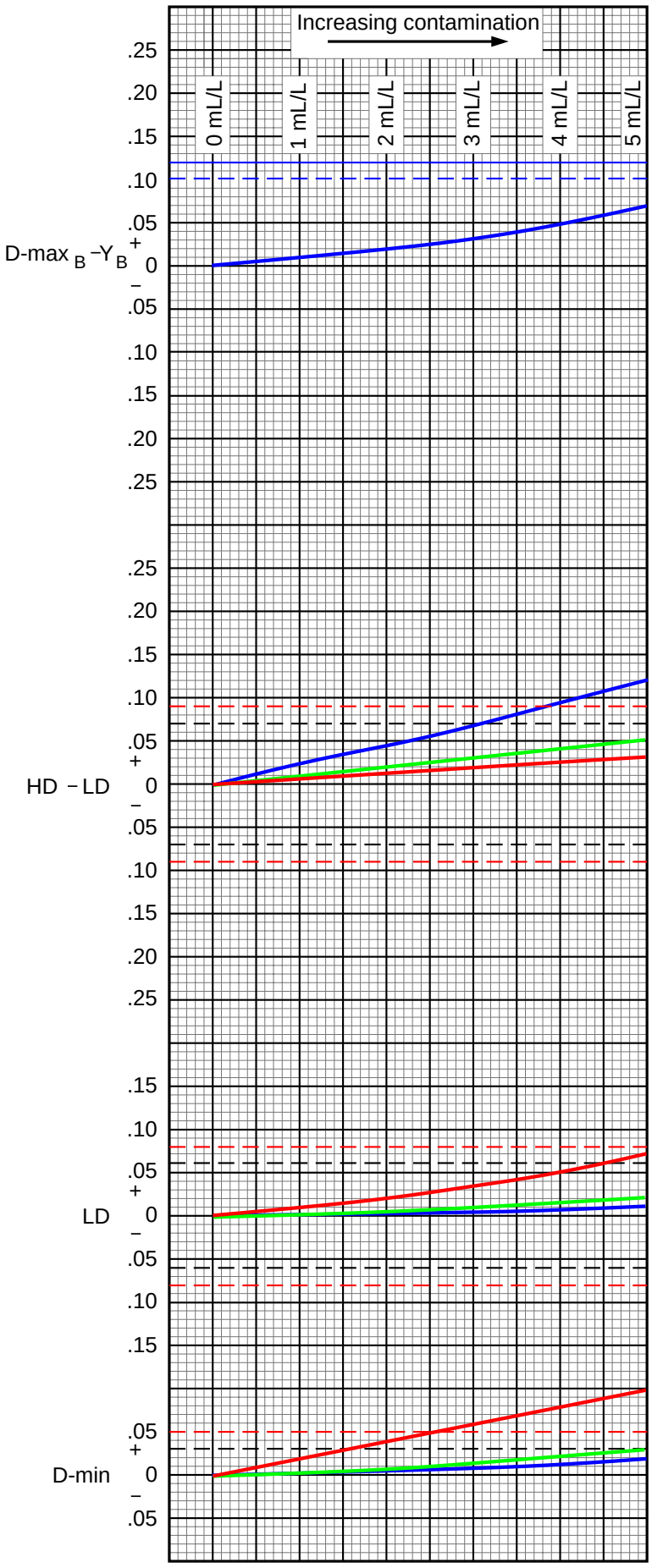
Very small amounts of fixer will contaminate the developer and cause chemical “fogging.” As contamination increases, dye density will increase in all of the control-chart plots. Fixer contamination is most noticeable as an increase in HD – LD and in the red D-min density.

Use different mixing tanks when you prepare developer and fixer replenisher solutions; minute amounts of fixer can contaminate the developer.

In minilab processors, fixer contamination of the developer usually occurs from leader cards that are not thoroughly clean. Clean all leader cards thoroughly in hot water each day at shutdown. Replace worn or damaged leader cards.

If fixer contamination occurs, stop processing customer film. After you locate and eliminate the source of contamination, dump the developer tank solution, rinse the tank thoroughly, and mix a fresh developer tank solution.

Chart 14



Bleach III—Too Dilute

If the bleach solution is too dilute, bleach activity is reduced, causing retained silver in the HD and D-max regions.

A dilute bleach tank can be caused by excessive developer carryover or a mix error. Be sure that your squeegees are working properly to minimize developer carryover. Check for mix errors in your bleach replenisher or bleach working tank.

If you suspect that a diluted bleach solution is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the $D\text{-}max_B - Y_B$ and HD – LD plots, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a known good bleach and then completing the remaining processing steps. To test for retained silver, follow the procedure given in *Appendix A*.

If you know the problem was caused by a bleach tank solution that is too dilute, add the amount of Part A, Part B, and starter shown in Table 5-3 for each litre of tank solution.

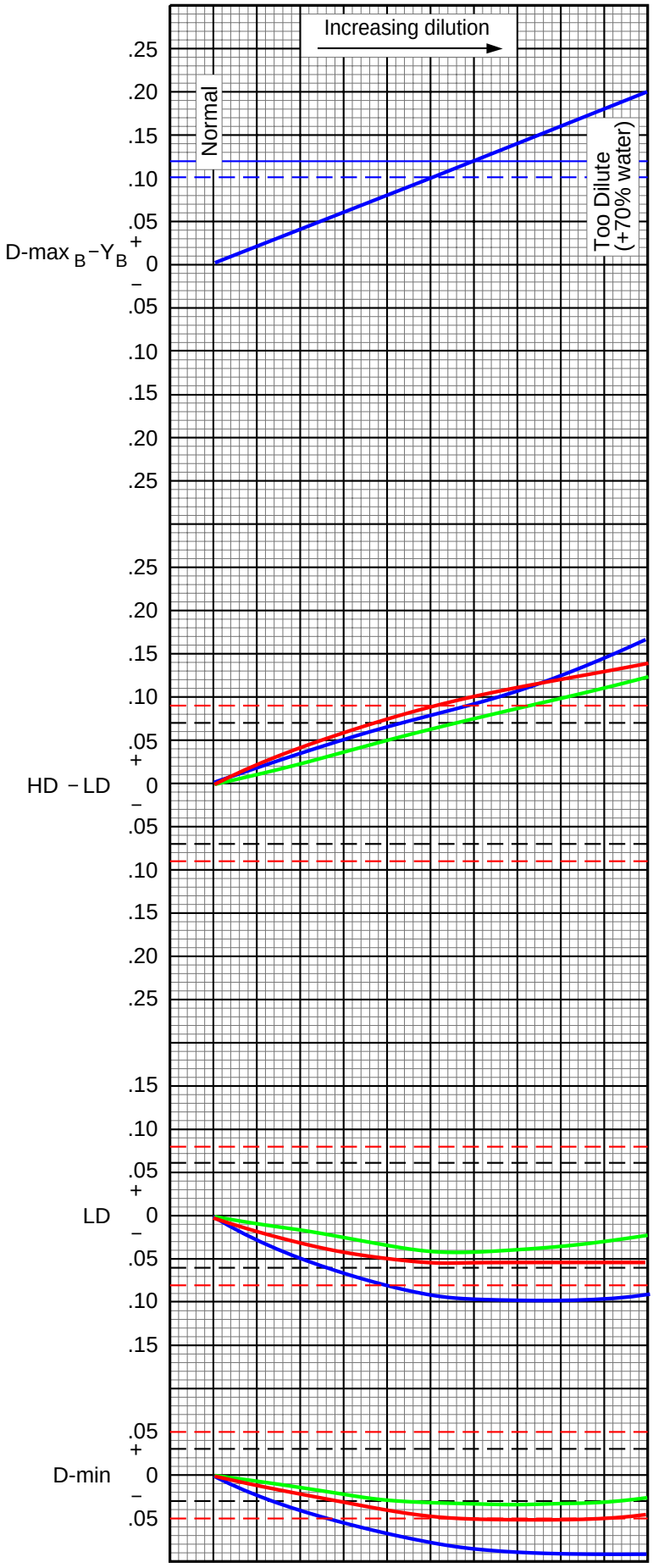
Table 5-3

	Bleach III Regenerator	Bleach III NR Replenisher
Concentrate	30 mL	35 mL
Starter	15 mL	13 mL

You may need to make more than one addition. Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. If, after several additions, retained silver is still a problem, replace the bleach tank solution.

If the bleach replenisher was severely diluted with water, replace it with a fresh mix.

Chart 15



Bleach III—
Replenishment Rate Too Low

A low bleach replenishment rate does not adequately compensate for developer carryover. This can reduce bleaching activity by diluting the bleach and raising the pH, causing retained silver. This is most noticeable as elevated plots in D-max$_B$ – Y$_B$ and HD – LD.

If you believe a problem is caused by incorrect replenishment, check the replenishment-rate setting, and reset it if necessary. Also check the developer exit squeegees to make sure they are efficient in limiting developer carryover.

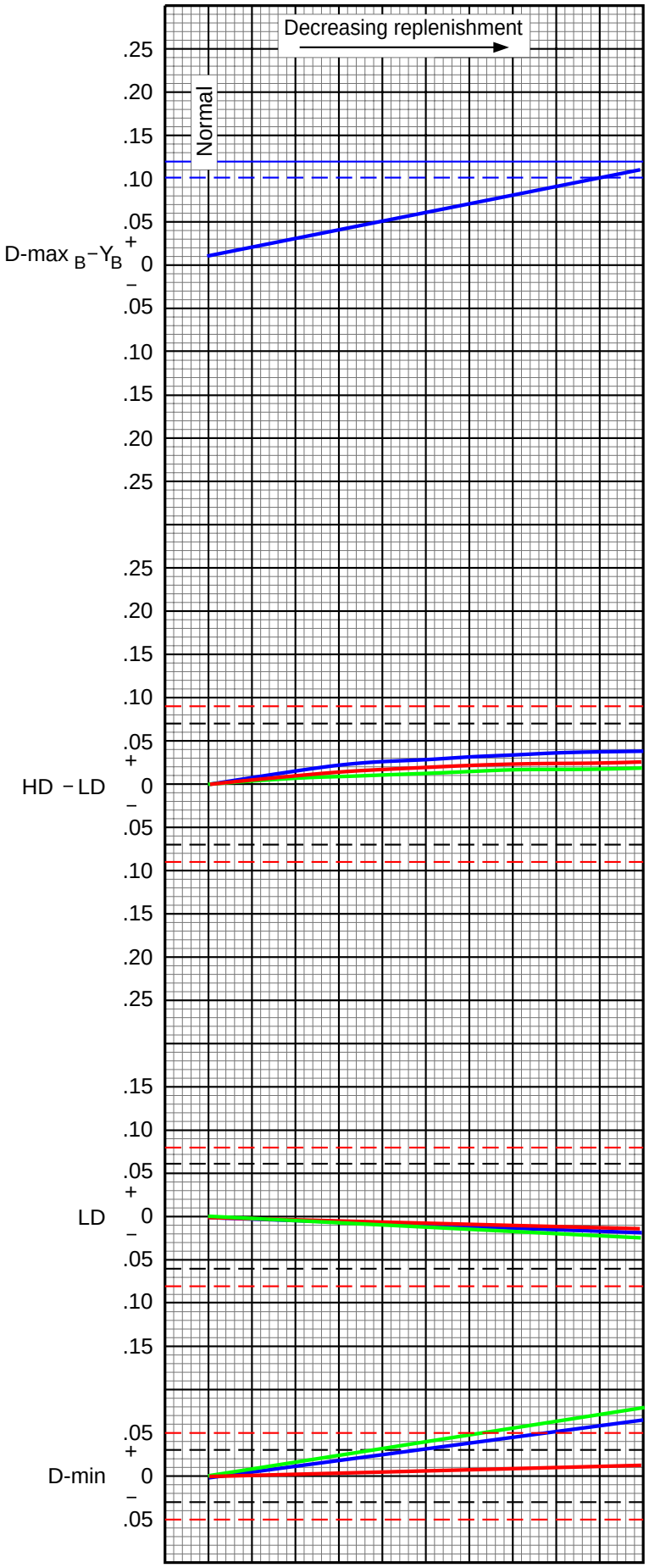
If you have verified that retained silver is the problem (by rebleaching or checking with an infrared scope) and it was *not caused by inadequate aeration*, add the amount of Parts A and B shown in Table 5-4 for each litre of tank solution.

Table 5-4

	Bleach III Regenerator	Bleach III NR Replenisher
Concentrate	30 mL	35 mL

Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. Repeat these additions until your control strips no longer have retained silver.

Chart 16



RA Bleach—
Replenishment Rate Too Low/High

Bleach activity is affected by improper replenishment. An underreplenished bleach solution will not adequately compensate for developer carryover. The pH of the bleach will increase and total iron will decrease, causing retained silver.

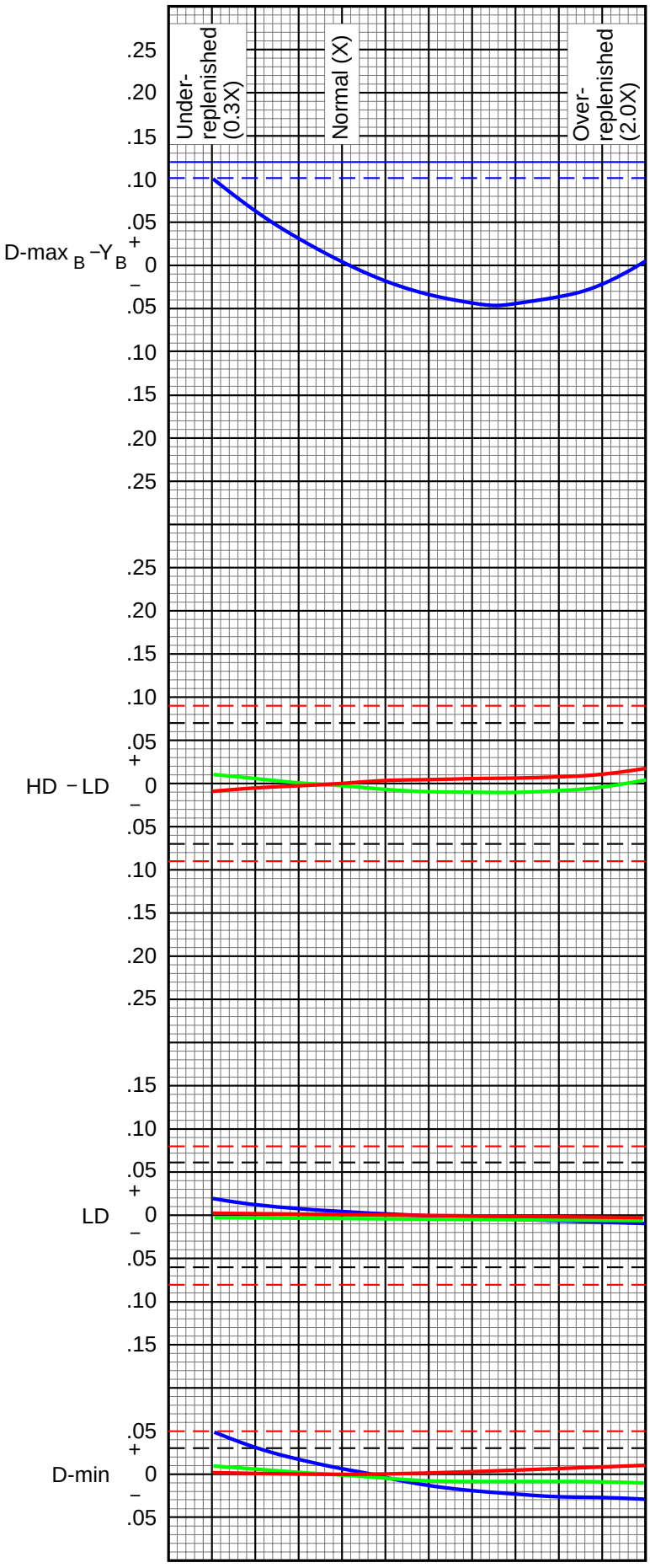
An underreplenishment problem is most noticeable in the D-max$_B$ – Y$_B$ plot and the blue D-min density. If you think that the problem was caused by incorrect replenishment, check that the replenishment rate and setting are correct for your processor; adjust them, if necessary. Check the bleach replenishment rate regularly.

You can correct film that has been improperly bleached by rebleaching it in a known good bleach and then completing the remaining processing steps. To test for retained silver, follow the procedure given in *Appendix A*.

If you have verified that retained silver is the problem (by rebleaching or checking with an infrared scope) and it was *not caused by inadequate aeration*, add 70 mL of FLEXICOLOR RA Bleach Replenisher NR for each litre of tank solution.

Turn on the recirculation and aeration, and allow the additional solution to circulate for at least 15 minutes before you run a control strip. Repeat these additions until your control strips no longer have retained silver.

Chart 17



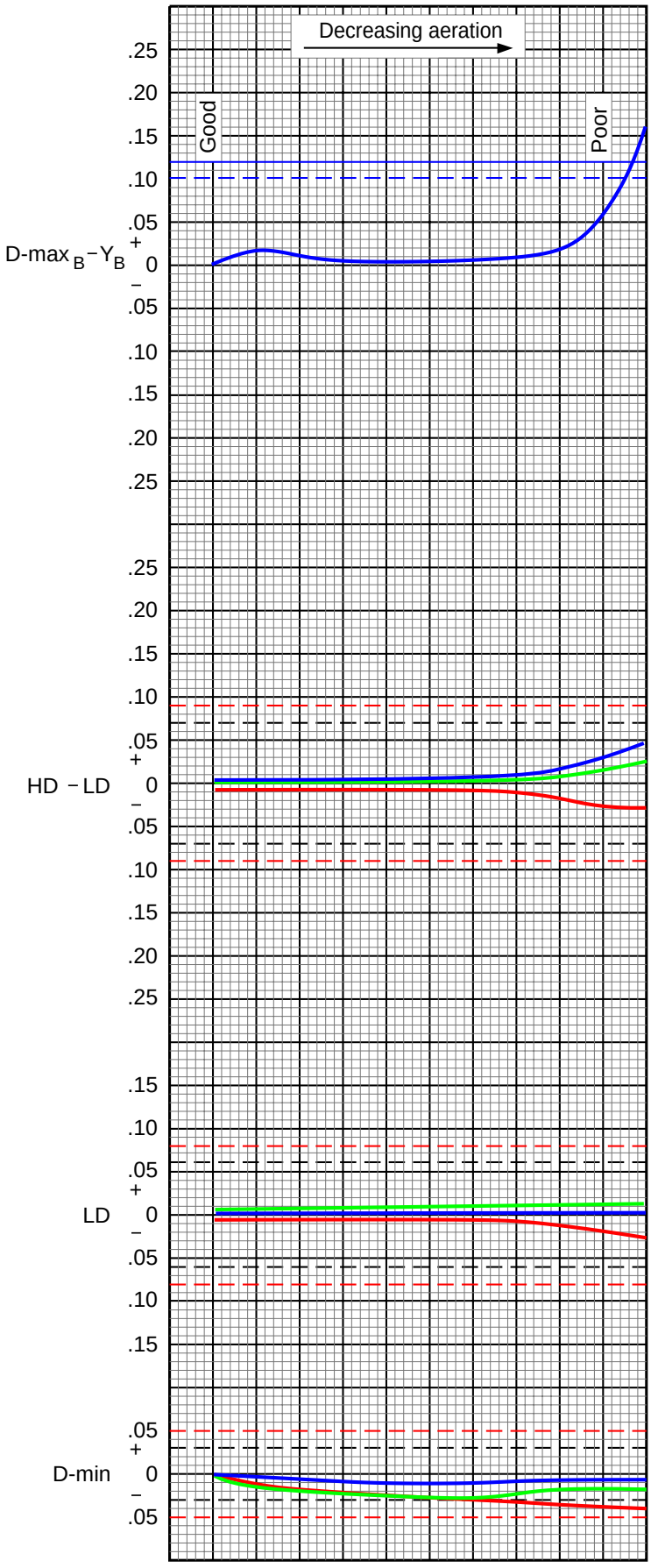
Bleach III — Poor Aeration

Bleach activity depends on the amount of bleach aeration. Inadequate aeration causes retained silver and leuco-cyan dye.

If you determine that the problem was caused by inadequate aeration, check the air bubbling in the bleach tank. Be sure that the air supply is adequate, the tubing is clear, and the distributor tube is not clogged.

If you think that poor bleach aeration is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the D-max$_B$ – Y$_B$ plot, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a good bleach and then completing the remaining processing steps. See *Appendix C*.

Chart 18



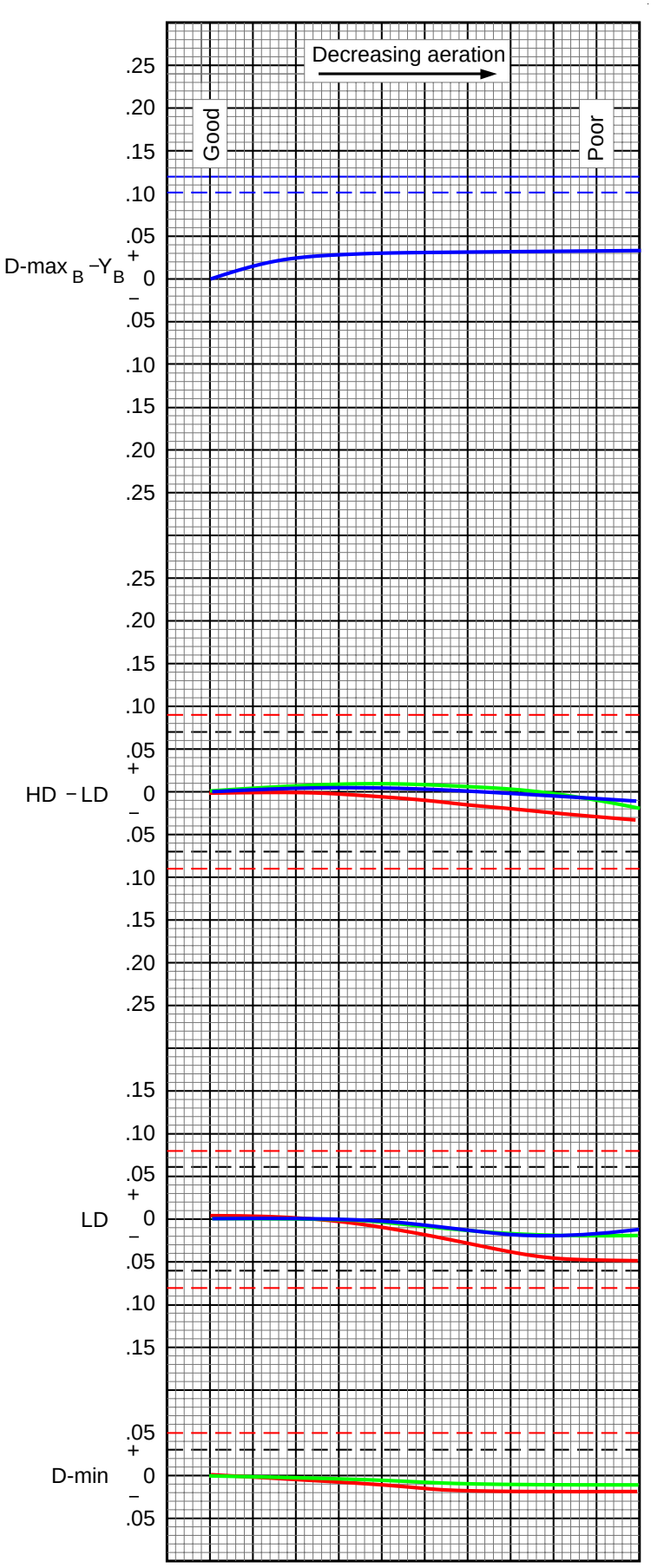
RA Bleach—Poor Aeration

Bleach activity depends on the amount of bleach aeration. Inadequate aeration causes retained silver and leuco-cyan dye.

If you determine that the problem was caused by inadequate aeration, check the air bubbling in the bleach tank. Be sure that the air supply is adequate, the tubing is clear, and the distributor tube is not clogged.

If you think that poor bleach aeration is causing an out-of-control condition, rebleach your control strip and then complete the remaining processing steps. If rebleaching significantly improves the D-max$_B$ – Y$_B$ plot, the problem was caused by the bleach. You can correct film that has been improperly bleached by rebleaching it in a good bleach and then completing the remaining processing steps. See *Appendix C*.

Chart 19



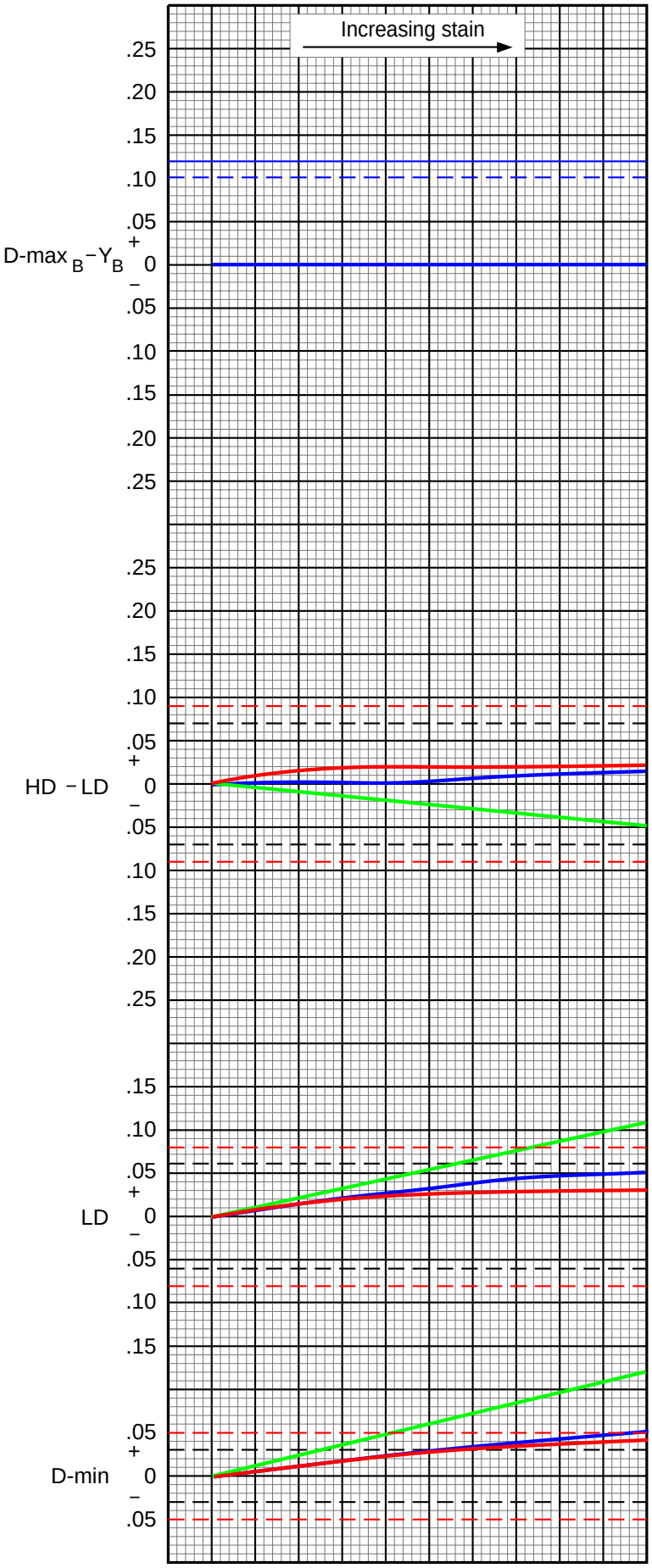
Bleach—Stain

Under some conditions, the developing agent from developer carryover can produce a by-product that causes staining in the bleach. This by-product can be absorbed into the film, increasing the D-min and LD densities, especially in the green (magenta) layer.

The staining by-product is caused primarily by underaeration of the bleach tank solution. It can also be caused by excessive developer carryover or underreplenishment of the bleach tank solution.

To test for bleach stain, follow the procedure given in *Appendix B*. Correct the cause of the staining condition; it may be necessary to dump all or part of the bleach tank solution. If staining is minimal, an activated carbon filter in the recirculation line of the bleach may help correct the problem.

Chart 20



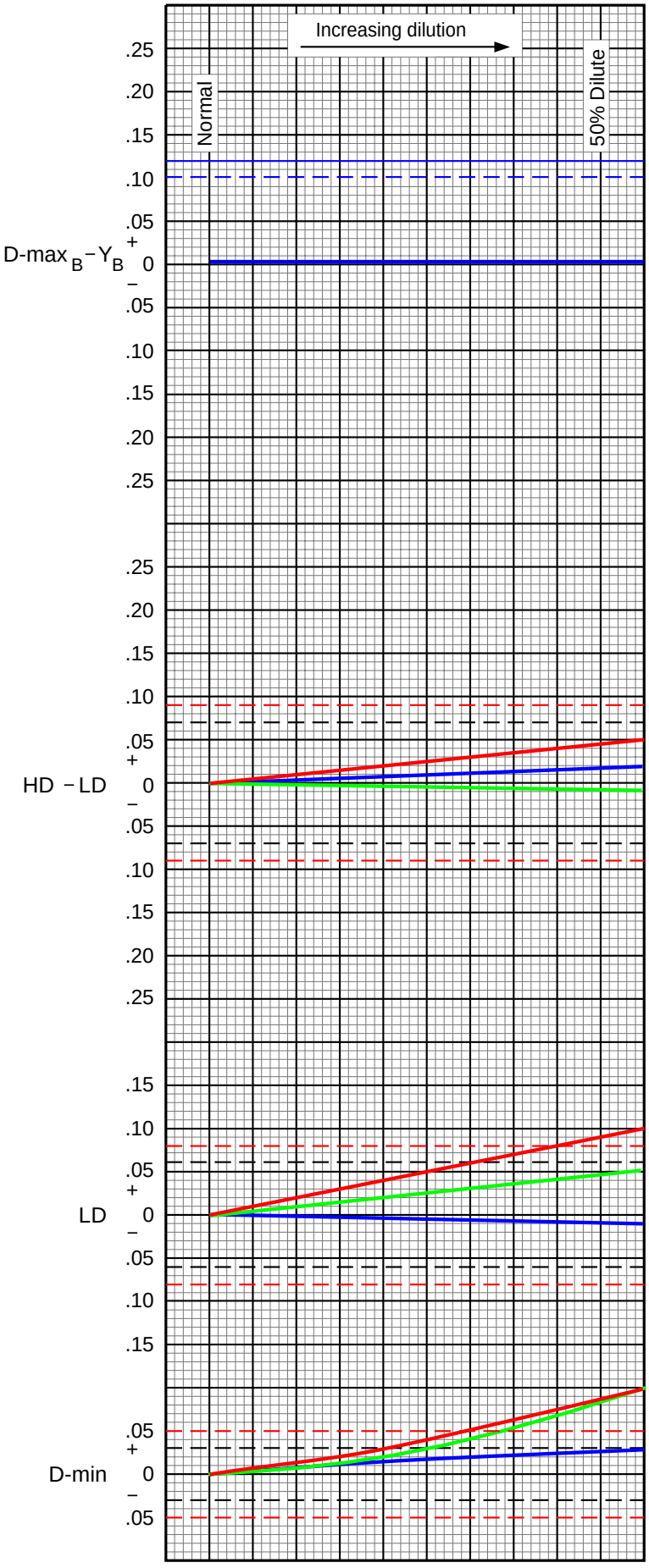
Fixer—
Too Dilute

Moderate levels of fixer dilution cause increased density in the red and green D-min and LD plots. When the fixer is extremely diluted, retained silver halide and sensitizer dye cause increased density in all control plots. When that occurs, the D-min areas of the film will appear milky.

The most probable causes of insufficient fixing are fixer dilution from excessive wash carryover, too little fixer time, too much water used to prepare fixer replenisher, fixer underreplenishment, and fixer sulfurization.

If you think that diluted fixer is causing an out-of-control condition, refix and rewash your control strip according to the procedure in *Appendix D*. If refixing significantly improves the red and green D-min and LD densities, the problem was caused by the fixer. You can correct film that has been incompletely fixed by refixing and rewashing it. Be sure to eliminate the problem that causes dilution.

Chart 21



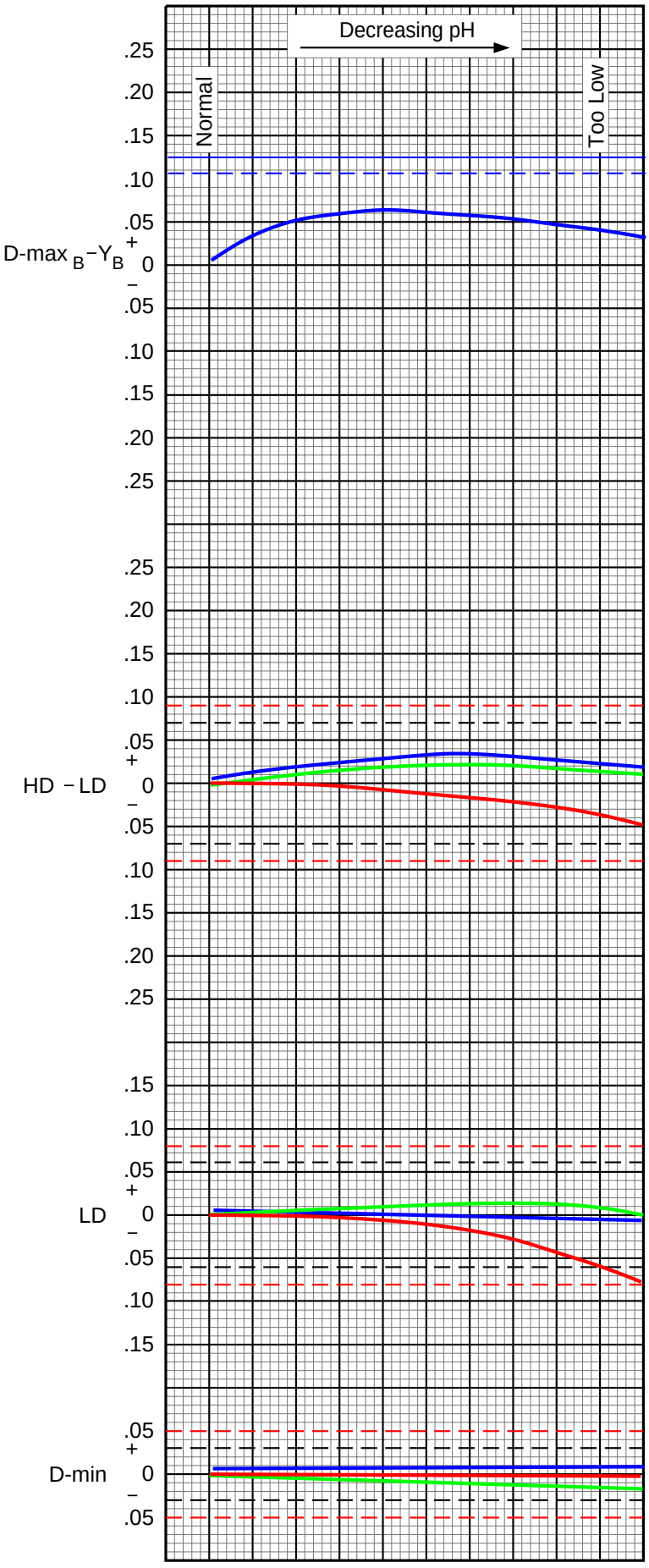
Fixer — pH Too Low

If you desilver fixer in a closed-loop system, a malfunctioning electrolytic silver-recovery unit or incorrect pH adjustments to the fixer replenisher can lower the pH of the fixer tank solution. If the pH of the fixer is too low, it can cause a leuco-cyan dye problem.

To determine if your fixer tank solution is causing a problem, refix your control strip in the suspect fixer tank solution. See *Appendix E*. If this test confirms that the fixer is the problem, replace it with fresh fixer. Be sure to correct the cause of the problem.

You can correct film that has been improperly fixed by reprocessing it, starting with the bleach step. Use a new fixer.

Chart 22



APPENDIX A

Rebleaching Test for Retained Silver

Use the procedure described below to verify retained-silver problems.

1. Zero your densitometer. Measure and record the blue densities of the D-max and yellow steps of your control strip.
2. Rebleach the control strip for 5 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. Refix the control strip for 5 minutes in a *known good fixer* (i.e., a properly constituted Process C-41 fixer or a solution made from KODAK Farmer's Reducer, Part B).
4. Wash the control strip for several minutes and allow it to dry.
5. Rezero the densitometer. Read the blue densities of the D-max and yellow steps of the rebleached and refixed control strip.
6. Calculate the **change** in density readings of the control strip by subtracting the readings from step 1 from the readings from step 5. We will refer to these numbers as Δ D-max$_B$ and Δ Y$_B$.
7. Subtract Δ D-max$_B$ from Δ Y$_B$ to determine the amount of retained silver. If the difference is greater than + 0.08, a retained-silver problem exists. If the difference is less than + 0.08, retained silver is most likely not a problem.

Note: You can remove retained silver from processed film by following these steps:

1. Rebleach the film in a *known good bleach*.
2. Refix the film in a *known good fixer*.
3. Run the film through the remaining process steps—wash, final rinse or stabilizer, and dry.

You can also use an infrared scope to detect retained silver.

APPENDIX B

Test for Bleach Stain

Use the test described below to determine if your KODAK FLEXICOLOR Bleach III tank solution is producing a stain in processed film. Use a portion of the D-min area of a KODAK Control Strip, Process C-41, that has been processed properly. The portion of the strip should be large enough for you to measure densities in two separate locations.

To test for bleach stain, follow these steps:

1. Cut a section of D-min from the width of a control strip that is approximately 13 mm ($\frac{1}{2}$ in.). The D-min densities should plot in control on your control chart. If you do not have a strip that provides in-control readings for D-min, use a portion of the D-min area of the reference strip.
2. Remove a sample of the bleach tank solution, and place it in a small container (e.g., fill a 100 mL graduate to the 75 mL mark with bleach). Start the test when the solution has cooled to room temperature.
3. Insert half of the piece of D-min into the bleach sample. Leave it in the solution for 20 minutes at room temperature with no agitation.
4. Immerse the entire D-min film sample in a still-water bath at room temperature for 20 seconds.
5. Allow the film to dry. Read the densities of both halves of the film sample. Compare the density readings. A difference of more than 0.12 density units in any color indicates staining from the bleach.

If staining is minimal, an activated carbon filter in the recirculation line of the bleach may help correct the problem. If staining is more severe, replace one third to all of the bleach tank solution. If the tank solution is a regenerated bleach, replace one third to all of the tank solution, overflow, and replenisher solution in your bleach system.

APPENDIX C

Test for Proper Bleach Aeration

Use KODAK Aeration Test Solution to determine if a bleach is sufficiently aerated to be effective. Use the test described below with KODAK FLEXICOLOR Bleach III tank solution.

Materials Needed

- KODAK Aeration Test Solution, CAT No. 129 2069
- Eyedropper or pipet
- Vessel for removing a bleach sample
- 10 mL clear glass graduated cylinder or test tube

Procedure

1. Thoroughly stir the bleach solution that you are testing, and remove a small sample.
2. With an eyedropper or pipet, remove a small amount of the sample, and place one drop of it in the graduated cylinder.
3. Add 5 mL of KODAK Aeration Test Solution to the bleach sample in the graduated cylinder.
4. Swirl the contents of the cylinder until the two solutions are well mixed.
5. **Within 5 minutes of mixing the solutions**, note the color of the mixed solution in the graduated cylinder, and then analyze the results according to Table 5-5.

Table 5-5

Solution Color	Condition
Blue	Properly aerated
Green	Adequately aerated
Brown	Not enough aeration

Note: This test assumes that the bleach solution being tested is at normal concentration; an under- or overconcentrated solution can produce inaccurate test results.

APPENDIX D

Test for Retained Silver Halide

Use this test to determine if processed film has retained silver halide.

1. Zero your densitometer. Read and record the red Status M density of the D-min step of a control strip that you have processed recently.
2. Refix the control strip for 5 minutes in a *known good fixer* or a solution made from KODAK Farmer's Reducer, Part B.
3. Wash the control strip for 2 to 3 minutes, and allow it to dry.
4. Rezero your densitometer. Read and record the red density of the D-min step of the refixed control strip.
5. Calculate the **change** in density readings by subtracting the reading from step 4 from the reading from step 1.

Any significant change in density readings after refixing indicates a fixer problem. If a *loss* in red density is greater than 0.05 for D-min or LD, a retained silver-halide problem probably exists due to low activity of the fixer tank solution. This problem may be accompanied by retained sensitizing dye. If the *loss* in red density is less than 0.04, the activity of the fixer tank solution is probably acceptable.

APPENDIX E

Rebleaching Test for Leuco-Cyan Dye

If the pH of a fixer tank solution is too low, leuco-cyan dye may form. To test for leuco-cyan dye formed in the fixer, follow this procedure:

1. Zero your densitometer. Measure and record the red LD density of a recently processed control strip.
2. Rebleach the control strip for 5 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 red LD density that you measured in step 1.
5. Calculate the **change** in density readings by subtracting the reading from step 1 from the reading from step 4. If the difference is greater than +0.08, a leuco-cyan dye problem exists. If the difference is greater than +0.05, a marginal leuco-cyan dye problem may exist.
6. If the fixer is the source of the problem, dump the fixer tank solution and replace it with fresh solution. For a closed-loop system, you may add sodium hydroxide or ammonium hydroxide to the fixer to adjust the pH to 6.5 ± 0.5 (check the pH with a pH meter). Also, check for fixer underreplenishment, a current that is excessive for in-line electrolytic desilvering, or excessive carryover into the fixer.

Note: You can convert leuco-cyan dye that formed in the fixer to normal cyan dye by following these steps:

1. Rebleach the film in a *known good bleach*.
2. Refix the film in a *known good fixer*.
3. Run the film through the remaining process steps—wash, final rinse or stabilizer, and dry.