MIXING SOLUTIONS

When mixing solutions, especially those intended for storage, all operations should be slowly and gently carried out, so that no air is introduced into the solution. Concentrated liquid developers keep well until oxidation begins. Once oxidation begins, it proceeds very quickly.

All developers will oxidize when exposed to air. MQ and PQ developers containing high concentrations of sodium sulfite are slow to oxidize. High-energy developers containing caustic alkali, developers containing pyrogallol, amidol, and many others, oxidize rapidly, and should be used immediately after mixing the working solution.

Sequestering agents

Sequestering agents are used in virtually all commercial developers to deal with water quality problems in some areas. For mixing formulas from scratch, Calgon has in the past been widely recommended. Today, EDTA (ethylene-diamine-tetraacetic acid) is more often recommended, but manufacturers seem to prefer a more recent form, diethylene-triamine-pentaacetic acid, pentasodium salt (40%).

Crawley does not recommend the use of sequestering agents in most developers, particularly high definition developers. We recommend not using sequestering agents when possible. It is usually economically feasible to use distilled or deionized water for mixing stock and working solutions of developers, which obviates the need for sequestering agents. Sequestering agents are not photographically inactive under all circumstances. For instance, Gordon Hutchings reports that using greater than 0.05 g/L of EDTA in PMK working solution results in loss of desirable stain. Nevertheless, he recommends the use of this chemical to smooth out uneven development "when all attempts to vary agitation patterns still yield uneven development."

Mixing and scales

Most of the formulas in this book are available in kits with each chemical premeasured from Photographers Formulary and Artcraft. If, like many, you prefer to mix from scratch, you will need a good scale. There are many fine scales available for accurately weighing chemicals. The scale should have readability to at least 0.1 grams and contain a counter-balance system, or tare, to compensate for the weight of the measuring container or paper.

Scales are available in either mechanical or electronic models. An

inexpensive mechanical scale, the Pelouze R-47, is available through camera stores in either metric or US Customary (Avoirdupois). It is accurate enough for quantities to 100 grams and has a good counter-balance system.

The next step up in a mechanical balance is the Ohaus Triple Beam Balance. The model 750 will weigh up to 610 grams, which is more than enough for the small darkroom. The Ohaus is about the best mechanical balance for less than $100. However, its tare-system is poorly designed. For this reason the Ohaus 1600 Series Dial-O-Gram, though more expensive, is a better investment.

For about the same price as the Ohaus 1600 the electronic Acculab Model V-400 is an excellent choice. The Acculab takes up less counter space than any mechanical balance and, being electronic, is more accurate and easier to use. The capacity of the Acculab V-400 is 400 grams and it can be switched from grams to ounces.

If you will often be weighing small amounts of chemicals like Phenidone, you will need a scale with readability and accuracy to two or three decimal places. Going from 0.1 g readability to 0.001 g readability more than doubles the price of the scale. A suitable though expensive scale is Acculab's V-3mg.

A convenient method for weighing small amounts of chemicals is to place them on pre-cut pieces of paper. Write the name and weight of each chemical on the paper, and arrange the chemicals on the mixing bench in the order of use. In this way they can be checked before mixing to avoid errors. For amounts over 20 grams, use a small Dixie Cup instead. Polystyrene weighing dishes are very convenient. They can be washed and reused. They are available from chemical and laboratory suppliers.

Working with the chemicals

Dissolve each chemical thoroughly before adding the next. Stir gently, to reduce the introduction of air into the solution, and never shake to dissolve the ingredients. Use glass, enamel ware, hard rubber, or plastic containers to mix the solutions. Metals such as tin, copper, or galvanized iron will react with the ingredients of the developer to create fog and other unpredictable effects.

For most developers the sulfite should be dissolved first in order to retard the oxidation of the reducing agent when it is added. The exception is metol which does not dissolve in a *strong* solution of sulfite. Fortunately, metol oxidizes slowly so it is usually acceptable to dissolve the metol first then immediately add the sulfite. The recommended method is first to dissolve a pinch from the total sulfite, then follow with the metol, then the rest of the sulfite.

Unless otherwise recommended use water at about 125F/52C. There are several exceptions to this. The first is when mixing caustic soda: sodium or potassium hydroxide. Both produce considerable heat when added to water. They should always be dissolved separately in cold water and then slowly stirred into the rest of the developer. Intense heat is also generated by combining sulfuric acid and water. Always add the acid to the water, and never the reverse, or serious injury may result

from spattering. Add the acid slowly, or the sudden heat may break the container if it is glass. **See the precautions in Appendix III before using hydroxides or strong acids.**

Another exception is any developer which contains pyro or amidol. Hot water accelerates their already too rapid rate of oxidation.

Note: Although 125F/52C is the almost universal recommendation for mixing photographic solutions in the US, in the UK, temperatures of 75-80°F are more commonly used. The idea is that, though mixing may sometimes be more difficult, there is less likelihood of agent decomposition. For most formulas the lower temperature works well.

Unless called for, filtering is not necessary if the water is clean. Any ordinary sediment will be precipitated out if the solution is allowed to stand without agitation until cooled. If filtering is necessary it is usually sufficient to filter through absorbent cotton or fine cloth that has been washed to remove any sizing matter it might contain. Other good filter materials are Bounty Microwave towels and paper coffee filters. Filtering through tightly woven paper or fabric is a slow process and should be avoided as it exposes the solution to the air, causing avoidable oxidation.

Special considerations

A few chemicals sometimes require special treatment to make them easily dissolve in water.

1. Phenidone tends to cake when added to water. It can be crushed in the bottom of the solution by using the end of a clean screwdriver (preferably stainless steel, and don't use glass). Dissolving Phenidone in a little alcohol first often helps. We owe to Paul Lewis the insight that dissolving Phenidone at 150F/65C seems to elmininate most solubility problems. The solution should be cooled as soon as possible. Although weighing out small amounts of Phenidone is difficult, using a stock solution of this chemical is not advised, as no solvent is known in which Phenidone is stable, although many recommendations have been published.

In addition, Phenidone does not have a long shelf life in dry form. The chemical should not be used for film developers if it has been kept for more than six months, though it can work acceptably in print developers at that point.

2. Sodium carbonate which has clumped together while dry may form a hard crystal that is difficult to dissolve. The solution is to grind the carbonate powder with a mortar and pestle (or the end of a clean screwdriver) before adding it to the solution.

3. Boric acid is always hard to dissolve, even at concentrations less than 5%. Leaving the solution overnight will usually work.

Storing stock solutions

Aeration, or oxidation, is the primary cause of developer deterioration. Most developers prepared with water that has been boiled to remove the gases and allowed to settle, or with distilled or deionized water, will keep well for at least three months if stored in a filled and stoppered glass bottle. Many stock solutions will last much longer than this.

Rodinal and PMK are particularly noted for long life. Developers that contain Phenidone may be the most difficult to keep long, so the simplest thing to do, if you need to keep a stock solution for months or even years at a time, is not to use Phenidone.

Oxidation occurs in proportion to the amount of air in the container and is often apparent by a change of color of the developer. However, many developers can oxidize without a change of color. To keep stock solutions for many months, an old piece of advice is to dip the top of the container in melted paraffin to seal out air. Adding glass marbles to the bottle to keep out air is another old trick. When available glass should be used in preference to plastic containers.

For those interested in the state of the art, here it is: Tetenal, more than any other photographic company, has devoted considerable research to the problem of keeping concentrated solutions fresh. First, noting that it is no longer feasible to ship chemical solutions in glass containers, Tetenal recommends that if solutions are to be stored for long, they should be transferred to glass after opening. But there is still air in the container. Removing that air can, according to Tetenal, extend the life of solutions by 2 to 4 times. Tetenal's Protectan Spray appears to be a compressed gas heavier than air, probably simple nitrogen. It is sprayed onto the surface of the solution, driving away the air, and the bottle is sealed until the next use. Photographers who already have nitrogen on hand for nitrogen burst agitation systems may be able to improvise a similar system. At the time or writing, Protectan is only available in Europe.

AN EXAMPLE OF IDEAL MIXING PRACTICES

Although it is not necessary to mix all developers in the stringent manner recommended below by Crawley for FX 1 and FX 2, his instructions for mixing and storing make an excellent guide for those who wish exact control over the variables in the process. These methods may be used with other developers as desired.

These stock solutions were designed with considerable care, and if stored properly, may be kept six months without deterioration, particularly the very stable FX 2.

FX 1 STOCK SOLUTIONS	
Stock Solution A	
Metol	5 g
Sodium sulfite anhydrous	50 g
Potassium iodide, 0.001%	50 ml
Water to make 1 liter	
Stock Solution B	
Sodium carbonate anhydrous	25 g
Water to make 1 liter	
Working Solution: 1 part A, 1 part B, and 8 parts of water. Stir gently for two minutes, and allow to stand for a minute more. Discard after use.	

Mixing stock solution A

Boil the water (you will need just over 2 liters for both solutions) for three minutes, then cool to about 86F/30C. Place 500 ml of water in a container. Stir in a pinch of the sulfite. Then gently stir in the metol, until dissolved. Follow with the sulfite, and finally the potassium iodide solution. Add water to make 1 liter. Filter, through coffee filter paper, preferably one free of additives. Fifty ml of the water can be replaced with isopropyl alcohol to improve keeping qualities and avoid precipitation in extreme cold. Store in securely capped, filled, glass bottles.

The stock solution will keep for a year unopened, or until discoloration is evident. A faint yellowish tint can be ignored, but anything deeper means the solution must be discarded.

Mixing stock solution B

Pour 500 ml of water in a container, stir in the carbonate, and stir gently until dissolved. Stir in water to make 1 liter. Store as above. This solution should be stored in plastic if it is to be kept for more than a few weeks, as it might etch glass. It lasts indefinitely in completely full bottles. In partially full bottles it should be replaced after two months to maintain consistency.

Single Solution Concentrate: The chemicals in solutions A and B may be mixed together in a single solution to make 1 liter. Again, alcohol may be used. Discard when discolored. The working solution is prepared by adding 100 ml of stock to 900 ml of water. This solution is not as stable.

FX 2 STOCK SOLUTIONS

FX 2 STOCK SOLUTIONS	
Stock Solution A	
Metol	2.5 g
Sodium sulfite anhydrous	35 g
Glycin	7.5 g
Water to make 1 liter	
Stock Solution B	
Potassium carbonate crystals	75 g
Water to make 1 liter	
Stock Solution C	
Pinacryptol Yellow 1:2000	
Working Solution: 100 ml A, 100 ml B, 3.5 ml C; water to make 1 liter of working solution.	

Mixing stock solution A

Boil slightly over 1 liter of water for 3 minutes and cool to about 86F/30C. Use clean mixing and storage containers. Measure out 800 ml of water, and gently stir in a pinch of the sulfite. Next add the metol, then the rest of the sulfite, and finally the glycin, making sure that each chemical is fully dissolved before the next is added. Stir gently with a rod, trying not to aerate the solution. If the glycin fails to dissolve, either add a pinch of carbonate (from the 75 grams) or, preferably, add 50 ml

of isopropyl alcohol, which will improve keeping qualities and resistance to precipitation in the cold. Add water to make 1 liter.

Filter the solution, and pour into bottles filled to the top, and securely capped. The solution keeps for a year unopened. It is a clear golden tint when fresh, and should be discarded when it discolors to a deep yellow, or a shade noticeably darker.

It is not necessary to use distilled water, although this is always a good precaution. Even if distilled water is used, filtering is necessary. Use a good grade of sulfite, relatively free from impurities, as well as really fresh glycin, if this developer is to be kept for several months.

Mixing stock solution B

Boil slightly over 1 liter of water for 3 minutes and cool to about 86F/30C. Dissolve the carbonate in 800 ml of water. Add more water to make 1 liter. This solution maintains activity indefinitely in a full bottle. However, renew a half-used solution after two months to maintain consistency. As with the FX 1 carbonate solution, keep in plastic rather than glass if you plan to store for more than a few weeks. All other photographic solutions should be stored in glass.

Stock solution C

Preferably, obtain this as a prepared solution at 1:2000 dilution. If you must mix it, dissolve the Pinacryptol Yellow first in a little alcohol, then in distilled water to make a 1:2000 solution. It keeps indefinitely away from strong light. However, after two years, an increase in activity may occur, and it should be discarded.

Most other developers can be mixed using these guidelines.

Appendix 3

CHEMICAL SAFETY

The way we think about safety has evolved dramatically in recent decades. Safety guidelines are, rightfully, much more stringent than ever. Yet experienced chemists often wonder if we have not gone too far in the other direction? If metol were discovered today it would probably not be approved by any regulatory authority. Indeed, all developing agents used today, except ascorbic acid (vitamin C), are toxic by today's standards. Yet, to place the application of the word "toxicity" in some perspective, many of the developing agents considered the most toxic are present in such common cosmetic products as permanent hair dyes, and powerful alkalis such as sodium and ammonium hydroxide are used in many common household cleaning products.

Even vitamin C is under a cloud of doubt as of 1998. Multigram daily supplements of vitamin C have been widely recommended for over two decades. Yet researchers have recently found that ingesting as little as 500 mg per day can cause measurable genetic damage in humans in as little as six weeks. Large vitamin C supplements apparently have oxidant, as well as antioxidant, effects. The vitamin C naturally present in food is said not to have these oxidizing effects.[1]

In spite of all these dangers, a recent 31-year study of photographic processors (working with both black and white and color films and papers) exposed to photographic chemicals full-time, on a daily basis, over most of their working lives, shows that *photographic processors have a lower mortality rate* when compared either to the general population or to all hourly workers. Nor was there any evidence of any increase in any particular cause of death. Commenting on these data, the Encyclopedia of Occupational Health and Safety concludes that "Based on available epidemiological information, it does not appear that photographic processing presents an increased mortality risk, even at the higher concentrations of exposure likely to have been present in the 1950s and 1960s."[2]

Although we are now accustomed to thinking of most chemical substances, including vitamins, as potentially toxic, it appears, in the ordinary black and white darkroom, that if we exercise ordinary prudence with chemicals, including not eating them, we are unlikely to suffer ill effects. Based on the available literature, ordinary prudence appears to mean taking reasonable precautions against chemical exposure to the skin, the respiratory system, and the eyes.

General guide to chemical safety

The *Focal Encyclopedia of Photography*, 3rd edition, contains an article entitled "Chemical Safety" by Grant Haist.[3] We reprint this section, with Dr. Haist's permission, in its entirety as a guide:

Safe handling of chemicals and solutions simply involves preventing any contact with human skin, eyes, or respiratory system or internal ingestion. Safety glasses or shields, an apron or laboratory jacket, and keeping the hands away from the face and mouth, will greatly minimize some of the potential dangers. Not smoking or eating candy or food in work areas will also help to eliminate possible mishaps. A workplace with adequate ventilation, or the use of a respirator, will limit the inhalation of air contaminated with dust, gases, vapors or fumes.

Good laboratory and darkroom practices should be followed at all times. Label all bottles and containers, keep them closed except when in actual use, and store them in cool, dry areas away from direct sunlight (out of reach of children). Store liquid and processing solutions safely. Breaking a gallon glass bottle of glacial acetic acid is a major disaster. Always add acids and bases slowly and carefully to the surface of the water. Do *not* add water to strong acids and bases. Do not mix chemicals haphazardly, even during final disposal.

Accidents, spills, and mistakes do happen during chemical handling and photographic processing. Clean up promptly all spilled chemicals and solutions. Do not wear sandals, opentoed, or canvas shoes as these provide little protection against spills or dropped containers. Clean gloves, aprons, and clothing or shoes that have become contaminated. Gloves, inside and out, should be clean to avoid chemical contamination of the skin, face, or mouth.

Prompt removal of chemicals from the skin is essential. Wash thoroughly with plenty of water any part of the body that may have contacted chemicals. See a physician if any chemicals reach the eyes, as few substances are not irritating or painful. Chapping of the hands from the drying and cracking effects of alkali on the skin or breaks in the skin from cuts and bruises are major points of entry of poisons into the body. Acid types of hand cleaners are sometimes recommended for the removal of highly alkaline solutions, such as color developing solutions.

Certain photographic chemicals and solutions require greater caution because they may cause allergy or contact dermatitis and skin sensitization of increased reactivity. Color developing agents and color developing solutions containing *para*-phenylenediamines, especially those of low water solubility, are primary causes of dermatitis. Black and white developers containing *para*-methylaminophenol (metol) or tanning developing agents, such as pyrogallol, also require care in handling. Gelatin hardening agents, particularly

formaldehyde, glutaraldehyde and chromium compounds, are potential sources of irritation. Certain chemicals that are relatively innocuous by themselves may react dangerously, even explosively, when combined with other chemicals. Other combinations of chemicals may emit poisonous gases, such as cyanide fumes or chlorine. Dangerous mixtures of chemicals are shown in the table.

Dangerous mixtures of chemicals[4]

DO NOT COMBINE	WITH
Acetic acid	chromic acid, nitric acid, peroxides, and permanganates
Ammonia	Halogens, calcium hypochlorite, or household bleach
Ammonium nitrate	Acids, chlorates, nitrates, combustible materials
Cyanides	All acids
Hydrogen peroxide	Most metals (particularly copper, chromium and iron) and their salts
Iodine	Ammonia
Nitric acid	Acetic, chromic or hydrocyanic acids, flammable substances
Oxalic acid	Silver
Potassium permanganate	Ethylene glycol, glycerol, benzaldehyde, and sulfuric acid
Sulfuric acid	Chlorates, perchlorates, and permanganates

Additional precautions

Keep all chemicals away from children and pets. If necessary, lock them up. Label and date all containers. Be sure storage bottles have a secure cap. Store chemicals in a cool, dry area away from direct sunlight.

Become familiar with all the inherent dangers associated with any chemicals being used. When acquiring chemicals, ask about proper handling and safety procedures.

Near the telephone, prominently display the telephone numbers for poison control, health information hot-lines (see **Other Sources** at the end of this chapter) and emergency treatment centers in your area.

Read and follow all instructions and safety recommendations provided by the manufacturer before using any chemical or chemical product. This includes mixing, handling, disposal, and storage. Request a Material Safety Data Sheet (MSDS) from the manufacturers of photo chemicals. Collect these in a loose leaf binder and keep it where someone can find it in an emergency. MSDS's and product label can be valuable sources of safety information.

Some chemicals, such as alcohol, are flammable. Keep them away from any source of heat or open flame to avoid a possible explosion or fire. Keep a fire extinguisher that can be used for both chemical and electrical fires in the work area.

If you are pregnant or have any pre-existing health problem, read all safety information carefully to determine if there are any additional precautions you should be aware of.

People have varying sensitivities to chemicals. If you have had allergic reactions to any chemicals, you should pay close attention to the effects that darkroom chemicals have on you, and you should be extra careful about following safety procedures.

"Proper ventilation is the first, and possibly the most important, expense, even before an enlarger and lens.

— Steve Anchell

Protecting your eyes

The most important factors in preventing accidental damage to the eyes are: wearing safety glasses with side shields or goggles or, at the very least, eyeglasses, and having in the darkroom a source of water that you can flush your eyes with that can be found even in the dark. If a chemical is accidentally splashed in the eyes, it must immediately be rinsed for at least 15 minutes in continuously running water, followed by immediate medical attention.[5]

Among other things Henry notes:

> Speed is paramount and every laboratory sink should (must) have at least one cold water outlet with an attached soft rubber hose with an easily findable valve so that, groping in the dark, you can easily find it and flush your eyes or whatever with cold water. I cannot overemphasize that, of all the major body organs prone to occupational injury, the eye is the most vulnerable.

Henry notes the hazards connected with wearing contact lenses in the darkroom. Other safety experts now believe that contact lenses may exert a protective effect by preventing the chemical from touching the eyeball. Immediately flushing will take out the contact as well as the chemical.

All of the material we have been able to find on eye safety makes clear that the major hazards are from accidental splashing of strong acids, such as hydrochloric acid, or caustic alkalis, such as sodium and potassium hydroxide. To avoid these risks, simply do not use these chemicals in your photographic processing. See the section below entitled "Avoiding strong acids and alkalis in photographic processing."

Protecting your hands

We strongly suggest the use of neoprene gloves when mixing and using photographic chemistry of any kind. Wear neoprene or nitrile gloves such as Bluettes or Bench Mark, both made by MAPA, and a plastic apron. Latex gloves are not suitable. Just as important as wearing gloves is cleaning them after use. Wash thoroughly in mild soap and water, and hang up to dry until the next use.

Protecting your lungs

Safety authorities often recommend the use of dust masks, or respirators, when mixing photographic chemicals. Some of the chemicals used by photographers are fine powders which may be hazardous if inhaled. Henry states: "Proper handling, however, can minimize the risk. Many chemicals, on the other hand, are crystalline, not fine powders.... Common sense tells you how to minimize dust problems. For example, in preparation of 1 quart of D-76 developer I fill up a container slightly larger than 1 quart with the prescribed 125F water, but short of the 1 quart mark placed on the container, cut off a corner of the D-76 packet and place the corner *below the water surface* and let the packet's contents fall into the water. Result—no dust. Remove empty packet and

carefully fold the top down to close the empty packet. Result—minimal or no dust. After the D-76 is brought into solution, water is added to a final volume of 1 quart and the solution mixed. Small amounts of powders can be weighed out or dissolved with a minimal or no dust problem if care is taken. For example, do not let the material on a spatula or plastic spoon empty on a weighing paper from any height greater than is absolutely necessary. This would definitely produce much more dust."

One recommended way of minimizing exposure to potentially hazardous dust or vapor is to have adequate ventilation in the darkroom. But in the real world, not every photographer has an adequately ventilated darkroom. In such a case, it is especially important to avoid using chemicals that emit gases or vapors. Avoiding acid fixers and stop baths is an excellent precaution. Keeping containers closed when not in use is another. In film development, avoiding the use of open trays by developing only in closed containers, will prevent the buildup of gases and vapors. If there is one thing more than another photographers should consider investing in, it is a well-engineered ventilation system for their darkrooms. The *Darkroom Cookbook* contains additional information on this subject.

Electricity in the darkroom

Avoid touching any electrical equipment with wet hands. Install shockproof outlets (ground fault interrupters) in your darkroom. Henry states: "*All* electrical equipment used in a darkroom should be properly grounded. If the wire cord has a 3-prong male connector, or has a UL (Underwriter's Laboratory) label on the equipment, you can assume proper grounding as long as the outlet receptacle will accept the 3-prong male plug. Similarly, if there is a 2-prong male connector with 1 prong larger than the other so that it can be placed in the female wall outlet only one way, you can assume proper grounding. If, however, there are only 2 prongs which are the same size, this signifies you have a problem and need to ground the equipment. Unless you are trained in such electrical problems, I can only advise you to have a qualified electrician do so for you."

Specific cautions for strong acids and alkalis

In addition to all other safety precautions, there are specific guidelines for handling strong acids and alkalis, particularly any hydroxide, and hydrochloric acid. Fortunately, it is possible to avoid completely the presence of strong, undiluted acids in the darkroom. It is harder, but not impossible, to avoid the hydroxides, which are useful alkalis. Hydroxides are used in Agfa Rodinal, photography's oldest continuously manufactured product, in the Windisch pyrocatechin developer, in Edwal 20, and in most monobath formulas.

Sodium hydroxide is a caustic alkali and possesses extremely corrosive properties. It can burn the skin, can cause blindness, and can be fatal if swallowed. The fact that sodium hydroxide is available in every supermarket as Drano is not an indication that this is a harmless chemical. The warning label on Drano makes clear that safe handling of

hydroxide requires care and caution. Wear some kind of protective eyewear, such as goggles, and gloves. Goggles are particularly important: you may not be able to feel a splash of sodium hydroxide on your eyes, and considerable damage to the tissues may be done before you are aware of it.

Mixing sodium hydroxide solutions

Begin with cold water and have ice handy in case the solution starts to boil. If it does, drop in the ice and leave the room until it cools! If any of the material falls or splashes on you or the counter top, wash it off immediately with water. If you detect a soapy feeling on your skin, sodium hydroxide is present.

The cardinal rule when mixing sodium hydroxide is to add the chemical to the water. **Never add water to the hydroxide.**

To begin, add a few pellets of sodium hydroxide to the cold water. Stir until dissolved. Monitor heat by touching the outside of the container. Keep on adding hydroxide slowly, a little at a time, allowing it to dissolve before adding any more.

Always wear safety goggles when handling sodium hydroxide. In the event of a splash, rinse with cold water for 15 minutes and seek medical help immediately.[5]

Mixing strong acids

The same precautions must be taken when mixing strong acids such as hydrochloric or sulfuric. The acid must be slowly poured into water, **never the other way around.** Always wear protective eye goggles.

In the event of a splash, rinse with cold water for 15 minutes and seek medical help immediately.[5]

Avoiding strong acids and alkalis in photographic processing

There is no need to be in contact with strong acids when developing films and prints. The only developer in this book that contains hydrochloric acid is Edwal 20. Simply avoid it, if you do not want to be in contact with strong acids. As we do not recommend the use of acid stop baths and fixers, it is easy to avoid their use. The only acid commonly recommended in this book is boric acid, which, at a pH of about 5, is one of the mildest of all acids, and is not commonly regarded as hazardous.[6] Sodium hydroxide is used in only four formulas in this book: Rodinal, the Windisch Pyrocatechin formula, and the two monobath formulas in Appendix I. These are easy chemicals to avoid. If you wish to use Rodinal, but would rather avoid the care necessary in mixing it, simply buy it prepackaged from Agfa. Even in this form, Rodinal requires careful handling, but the prepared solution should have a pH considerably lower than a sodium hydroxide solution. Even so, if you have decided not, in ordinary darkroom use, to use protective eyewear, then, at the very least, you should use protective eyewear when you develop with any developer containing a hydroxide.

Acetic acid is the acid in common vinegar, usually at a level of 4-5%. It is used in some of the acid fixers formulas given in this book, though none of them are recommended. It is also listed in the formulas for acid

stop baths, none of which we recommend. It is thus possible to avoid acetic acid in common photographic processing. If you choose to use acetic acid, do not use glacial acetic acid (99%). Instead, use the far more common 28% solution sold by photographic chemical suppliers.

Special cautions for pyrogallol and pyrocatechin

According to Gordon Hutchings, "Pyro may be the most toxic chemical used in the darkroom. The combination of toxicity and the ease of bodily absorption demands careful handling of the chemical. It is not a matter of individual sensitivity. I know of a few longtime pyro users who have not exercised normal precautions and are experiencing the debilitating effects of kidney dysfunction or other illness. It may take a lifetime for the damage to occur, but the effects are inevitable. Despite the danger, however, it is not difficult to avoid the harmful effects of pyro." Hutchings also notes that pyrocatechin should be used with the same precautions as pyrogallol.[7]

Hutchings then presents several pages of material on safety precautions which pyro and pyrocatechin users should read. It appears that the greatest danger with pyrogallol is in developing films in a tray with bare hands. Using gloves while tray developing is thus an essential precaution. Hutchings notes that "for most non-tray film processing, there is no need for gloves. A drop or two of the developer on the hands is relatively harmless. All tank, reel and nitrogen burst systems may be operated without gloves. Each photographer will have to decide what level of exposure is acceptable."

The additional level of risk that using staining developers entails can be avoided by simply not using them.

Disposal and safety

When working with any chemical, you assume the responsibility for its safe use and disposal. Follow any special instructions included with each chemical or process being used. Laws concerning disposal of chemicals vary widely. Contact the Hazardous Material (HazMat) Unit of your local fire department. They will explain in detail exactly what you can and cannot do in terms of disposal in your area.

Read MSDS sheets for disposal information. Do not mix any chemical with any other chemical unless you know it is safe to do so. Do not mix liquid and solid wastes together, as dangerous reactions might occur. Be sure to read and follow all safety recommendations that come with the chemicals.

Follow instructions for proper disposal of all chemicals. Wash yourself and any equipment that has come into contact with any chemicals. Launder darkroom towels after each session. Dispose of gloves and disposable masks to avoid future contamination. Keep your work space clean and uncontaminated.