Film Development Procedure

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The procedure I use to develop black and white film.

1 Loading The Development Tank

The first step is to get the film into the development tank in complete darkness. Either in a dedicated darkroom or by using a film changing bag. I use a changing bag myself.

There are two types of development tanks. Plastic and stainless steel.

Plastic is probably most commonly used nowadays but comes with some disadvantages. The film is pushed onto the reel using a feeding mechanism and the film can get stuck unless it's absolutely dry. Slight perspiration in a changing bag is enough to make this happen. It can also be difficult to clean plastic reels thoroughly, they may become gummy over time.

Stainless steel reels are loaded by attaching the film onto prongs and winding the film from the center, They may be more difficult to load in the beginning, but with practice I would argue it's a more reliable method. This type of reel and tank also come with some disadvantages. The sides of the reels must be parallel or it's easy to cross or double thread film. This means taking care of the reels, dropping them may ruin them. Stainless steel tank lids also commonly leak during development, but this is only a slight nuisance.

I recommend a stainless steel development tank with good reels. Hewes are considered by many to make the best stainless steel reels.

2 Preparing the Chemicals

All chemicals need to be brought to the same temperature before development starts. This is accomplished with a water bath, for example in the kitchen sink. Development can take place at different temperatures, commonly at 20 or 24 °C. I recommenced to standardize on one temperature unless there's a good reason to deviate.

1-liter wide-mouth bottles are needed to hold working solutions of developer, stop bath, fixer and post wash. The post wash is optional. As described in chapter 3, it may be needed depending on the local water quality.

A big 4-liter bottle or container to hold the water for washing the film after development.

Fill all bottles and put them in the water bath. Development can commence when all solutions has reached the same temperature. Preferably a temperature standardized by your development procedure.

Also put the development tank in the water bath to bring its temperature in line with the fluids.

3 Developing the Film

Black and white film is typically developed in two chemically altering steps. First the film is developed so that the negative image is formed. Then the film is fixed to remove undeveloped silver. In between these steps, the film is washed in a stop bath to prevent contaminating the fixer. The developer is alkaline and most fixers are (and should stay) acidic. One liter of diluted fixer can be used for around 10 rolls of film. There is no need to use an acidic stop bath with film development. A water stop bath suffice, and is even recommended by many.

The film needs to be thoroughly washed after fixing or its archival properties suffer. The economical way to do this is with the "Ilford method". The film is put though several washing cycles of fresh water, diluting the remaining fixer until it's hopefully homeopathic. The first washing cycle consist of filling the tank, agitating for 5 cycles and dumping the water. Repeat with 10 cycles and 20 cycles of agitation for the second and third washing cycle respectively. Add an extra forth washing cycle for good measure.

Depending on local water quality it may be advisable to let the film soak in some deionized or distilled water with some wetting agent for around 10 to 15 minutes after washing. Hard water can leave stains on the dried film that is difficult to remove. The clean water slowly leech out deposits and the wetting agent breaks the water surface tension so the film dries evenly.

Finally hang the film to dry in a dust free area. It's difficult (impossible?) to find a dust free area in a common household. Running the shower hot for a couple of minutes is a trick to get rid of floating dust particles and then drying the film in the shower area. Shake the development reel to get rid of as much water as possible before hanging the film to dry. Try to resist any temptation to touch the film when wet, except for maybe with a film squeegee to remove excess water. The film is quite sensitive in this stage and is easily scratched.

Agitation

Agitation ensures that fresh chemistry is in contact with the film during development. There are some different schemes, it's most important to stay consistent or development times will vary.

Agitation is performed in cycles over time. One cycle consist of turning the development tank upside down while rotating it around its axis and then back again. Place one hand on top of the tank and the other at the bottom.

The agitation scheme for developer and fixer is 30 seconds initially and then 10 seconds at the start of each minute. The longer initial agitation reduce the risk of uneven development. Typically 10 seconds of agitation corresponds to 3-4 cycles.

Rap the development tank against a work bench or similar to dislodge any air bubbles clinging to the film before letting it rest between agitations. This step is important as stuck air bubbles will result in visible spots on the developed film.

Detailed Steps

Develop

Pour the developer into the development tank. Agitate as described for the development time of the particular film. Empty the tank. Refer to chapter 4 for disposal.

Stop

Pour the stop bath into the development tank. Agitate continuously for 30 seconds. Empty the tank into the sink.

Fix

Pour the fixer into the tank. Agitate as described for double the clearing time of the particular film. Refer to chapter Testing the Fixer for how to determine the fixer clearing time. Empty the tank into the fixer bottle for reuse.

Wash

Wash the film using the "Ilford method" as previously described.

Post Wash

Pour the deionized or distilled water into the development tank. Agitate for a few cycles and add the wetting agent. Let the film soak for 10 to 15 minutes. Don't agitate with the wetting agent or it will foam.

Dry

Dry the film as previously described.

Clean

Clean the equipment after use so that no chemicals are left on it. Use a dedicated wash up sponge for obvious reasons.

4 Safety and Environmental Concerns

I have alluded to film development taking place in the kitchen by giving the example of using the kitchen sink as the water bath. Many black and white photo chemicals are quite harmless and I don't believe this to be a reckless suggestion. Do what you feel comfortable with and research the toxicity of used chemicals beforehand.

Some film developers are non-toxic enough that they can be dumped into the sink (e.g. Kodak XTOL). Others need to be taken to an environmental recycling center.

Spent fixer should always be taken to an environmental recycling center. It contains dissolved silver which is toxic to organisms.

5 Tips and Tricks

Chemical Storage

This guide has described the need for temporary storage containers for the different chemicals (and water baths) during development. There is also a need to hold diluted working solution of fixer, possibly mixed developer and wetting agent. The number one enemy of these chemicals is air. Use brown glass bottles and always try to fill them to the brim to prevent oxidation. Despite these measures, the chemicals have a due date.

Removing Watermarks

Despite best intentions, water marks can form on the dried film. The film drying is the hardest step to perfect in my experience.

Watermarks on the shiny side of the film can be removed using a micro fiber cloth and a few drops of deionized or distilled water. Place the film strip on a dust free surface. Put a few drops of water on the strip using a Q-tip and wipe the strip with the cloth. Make sure the cloth is soft and clean or it will scratch the film. Never touch the emulsion side.

Testing the Fixer

The fixing time can be determined by clearing a strip of undeveloped film in the fixer. Take note of the time it took for the film strip to clear. Use double this time when fixing the film. Please note that fresh fixer clears film faster then when used a couple of times.

Testing the Developer

The developer potency can be tested by developing a strip of film (in broad daylight) and then fixing it. If the strip is black after fixing the developer is potent.

Dosage of Wetting Agent

Some wetting agents require very high dilutions (such as 1:400). Preparing a working solution makes it easier to dose properly (for example 1:50). I mix this working solution with isopropyl alcohol to prevent growth of organic matter; it also allegedly prevents streaking on the film when drying.

It may also be worth experimenting with the dosage if there are marks on the dried film. There are different kind of marks and it's difficult to explain without pictures but some are the result of using too much wetting agent. Others are left by hard water deposits.