# INTRODUCTION TO THE FPC PROCESS CONTROL MANUAL

## A SYSTEM OF PROCESS CONTROL FOR ALL BLACK AND WHITE FILMS

The ILFORD FPC (Film Process Control) system is designed to provide you with a flexible and easy to use method for controlling the performance and quality of your replenished black and white film processing systems. The information it contains is designed to make it easy for you to set up and organise a bespoke film process control system tailored to your processing needs.

The intention is for you to build an ILFORD FPC manual from the technical documents we provide, along with information from other sources, that act as a single store for all the information you need for each film process system you have.

The FPC manual you create should be designed as a central information store for all aspects of your film process. We suggest you create an FPC manual for each film processor or film process system that you operate.

The ILFORD FPC fact sheets should form the heart of any FPC manual that you build. The manual is customised to your needs by adding ILFORD process control fact sheets and other ILFORD fact sheets and technical information relevant to your process. You can also use it to store a wider range of information, such as processor instruction manuals, your favourite development times, information about the chemicals you use, contact names and phone numbers, technical information from other film manufacturers, etc.

An FPC manual can contain the following ILFORD information:

1 The ILFORD FPC process control fact sheets

2 The fact sheets about the ILFORD developer and other chemicals that you use.

3 A supply of ILFORD process control charts.

4 A supply of ILFORD user data sheets, for customised development times, contact names and phone numbers, etc.

5 Fact sheets and technical information leaflets for ILFORD films.

6 Heath and safety data sheets about the ILFORD chemicals you use

7 Effluent data sheets about the ILFORD chemicals you use

All of the above can be downloaded from our web site at . **www.ilfordphoto.com**

Other information should also be added, such as:

8 Fact sheets and technical information leaflets from other the manufacturers of other films.

9 The operation manuals and user instructions for the processor.

10 The processor service manuals and records.

## WHY A FILM PROCESS CONTROL SYSTEM IS IMPORTANT

One of the main aims in professional processing is consistency. For a developer to give repeatable results day to day, it must be maintained in a stable condition, unfortunately, every film that is processed will change the condition of the developer. Development is simply a chemical reaction that uses up some of the active ingredients in the developer and introduces some waste products into it. The major effects on the developer of processing a film are:

1 pH changes, making the developer more acidic.

2 Developing agents are used up

3 Waste products, mainly bromide, are introduced into the developer.

In addition, age and temperature have an effect on the performance of a developer. Developers react with air (oxidation) that causes some of the active ingredients to breakdown and reduce activity. High temperatures can speed up this process.

There will always be a difference between a tank of fresh developer and a tank of used or seasoned developer in performance. However, a well set up replenishment system compensates for the effects of use and age so that the performance of the tank developer remains stable for many months.

You can only be sure that your process is in good condition and continues to be so if you regularly test it. To be able to test accurately and reliably a good system of process control is invaluable as it provides an independent and measurable method. The test results can be plotted and documented to create a record of the process system's performance throughout its time of use. This can be used to demonstrate performance consistency to others or to help with the identification and diagnosis of problems. A well-run film process control system will give you confidence in the consistency of the film processing services you provide for your customers.

## PROCESS CONTROL

The remainder of this fact sheet explains what happens during processing and the basics of process control that may be of help when training operators and laboratory staff. It also gives some guidance on the basic laboratory techniques and equipment that are needed.

A process control system works by keeping all the possible photographic variables constant except the processing. A known film strip is exposed to a series of controlled exposures and then processed to create a benchmark. When similarly prepared films are subsequently processed any changes between them and the benchmark strip reflect the changes that have happened in the processing system.

For your convenience ILFORD supply specially prepared pre-exposed ILFORD FP4 Plus PROCESS CONTROL STRIPS. Alternatively you can expose your own film strips on any film using an appropriate sensitometer.

The basic elements of a process control system are:

### Process control strips

These are film strips pre-exposed with a number of density steps. When a strip is processed, the steps develop to densities specific to your process.

### A densitometer

This is essential for measuring the density of the steps on your process control strips. A visual assessment of density cannot be used for accurate process control, as it is not a measurement.

### A process control chart

This allows you to plot the densities measured with the densitometer. The shape of the plots over time tells you how the process is performing and will give you warning of any significant changes that may happen. If changes do occur it will help you to identify possible causes.

## PROCESSING

Processing comprises six main steps: development, stop bath, fixing, washing, wetting agent rinse and drying. In some process systems the stop bath and wetting agent rinse may be left out as they are not essential to processing, however their inclusion does help to make it easier to maintain consistent processing and we recommend they are included if it is possible.

Agitation is used in most of the processing baths; the method used depends on the processor. It is most critical in the developer and fixer, where it prevents uneven or patchy development and fixing. Consistent agitation, solution temperature and process times are essential for consistent processing.

### Development

A film emulsion contains many small crystals of silver halide, which are sensitive to light. When the film is exposed, small silver particles are formed on the surface of any crystals that have been exposed to light and so form the latent image. However, in this state the exposed particles are too small to see. Development increases the size of these particles by converting all of the crystals with silver particles into silver grains that will form the visible image.

### Stop bath
Although this bath is not found in every processor we recommended its use whenever possible as the developer carried out of the developer tank by the film is still active. A stop bath between the developer and fixer does two things, as the name implies, it stops development in a matter of seconds but it also helps to prolong the activity and life of a fixer bath. Developers are mildly alkaline chemicals whereas the stop bath is acidic, the change from alkali to acid conditions stops development. Fixer baths are mildly acidic and they become less efficient as they become neutral and will stop working in alkaline conditions. Over a period of time carrying alkaline developer straight into the fixer can affect the fixer's performance. If a stop bath has been used it has neutralised the alkali in the developer on the film and prevented it from being carried over into the fixer. The carry over from stop bath into the fixer is acidic.

### Fixing
After development any silver halide crystals not exposed to light will remain in the film. If they were allowed to remain these crystals would obscure the developed image, making it unprintable, and unstable. The fixer dissolves the unexposed crystals, leaving the silver grains that form the image untouched and clearly visible.

### Washing
After fixing the unexposed silver halide crystals have not been fully removed, only dissolved. The developed image will be unstable if the dissolved silver halide crystals are not removed. Washing ensures that all of the dissolved silver halide is removed from the film.

### Wetting agent rinse
This rinse is not found in every processor. This is normally the final bath in a process. It is designed to spread the remaining water evenly on the film's surfaces as it enters the dryer. Its use promotes even drying.

### Drying
This is probably the cause of more problems than all of the rest of the process put together. To dry the film, warm air is blown over the wet film by a fan. The aim is to dry the film evenly in a dust-free atmosphere. The drying temperature and time are important factors in good even drying, this is particularly so when drying temperatures are high and drying times are short.

## THE PROCESSING VARIABLES
These are the most important variables in any processing system. If they are not kept constant, the process will give very unreliable results. Check these variables first if your process goes out of control.

Development time

Developer solution temperature

Developer agitation

Developer replenishment rate

Fixer time

Fixer solution temperature

Fixer agitation

Fixer replenishment rate

## PROCESS CONTROL
An example of a partly completed process control chart is overleaf.

Process control is a way of monitoring a process so that changes can be detected before they have any detrimental effect on the quality of the negatives produced.

A process control system measures three important variables: speed (LD in the FPC system), contrast (HD–LD in the FPC system) and minimum density (Dmin in the FPC system). These are plotted on a control chart, where any variations can be detected from the shape of the plots.

As long as the plotted line stays within the 'action' lines marked on the chart, the process is in control, this is an acceptable level of variation. If the plotted line drifts beyond the 'action' line, but is still within the 'control' line, processing can continue but the cause of the drift needs to be identified and corrected. If the plotted line goes beyond the 'control' line, processing should stop until the cause of the problem is investigated, identified and rectified.

More detailed information about using process control is given in the FPC fact sheets 'ILFORD FP4 Plus CONTROL STRIPS & PROCESS CONTROL' and 'PROCESS CONTROL FAULT FINDER GUIDE'.

# ILFORD FPC MANUAL

## PROCESS CONTROL CHART

DEVELOPER ILFOTEC RT RAPID | DILUTION 1+1+2 | DEVELOPMENT TIME 50 secs

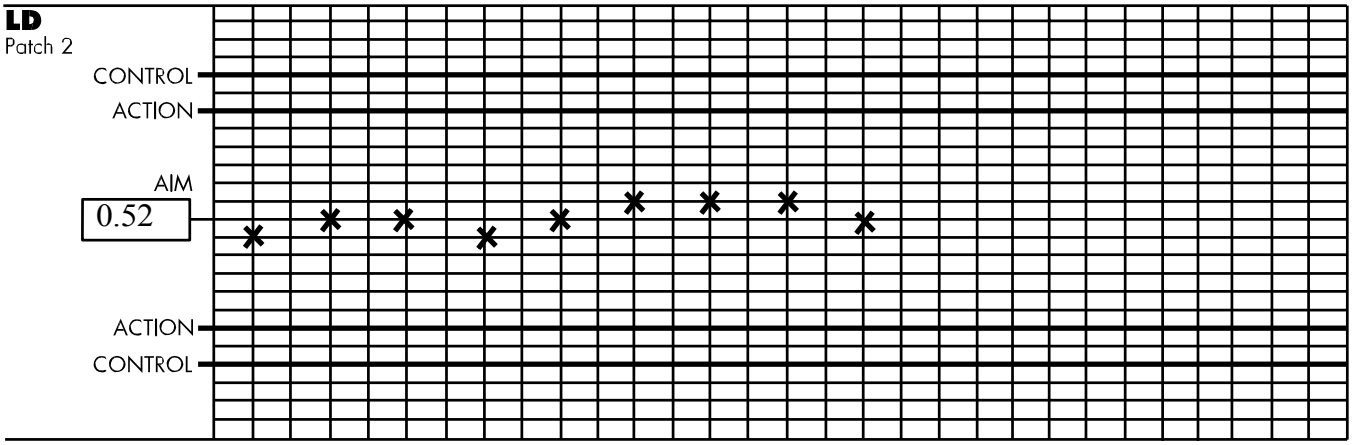
PROCESSOR ILFORD FP40 | CHART NO 1 | FROM 1/12/2003 | TO

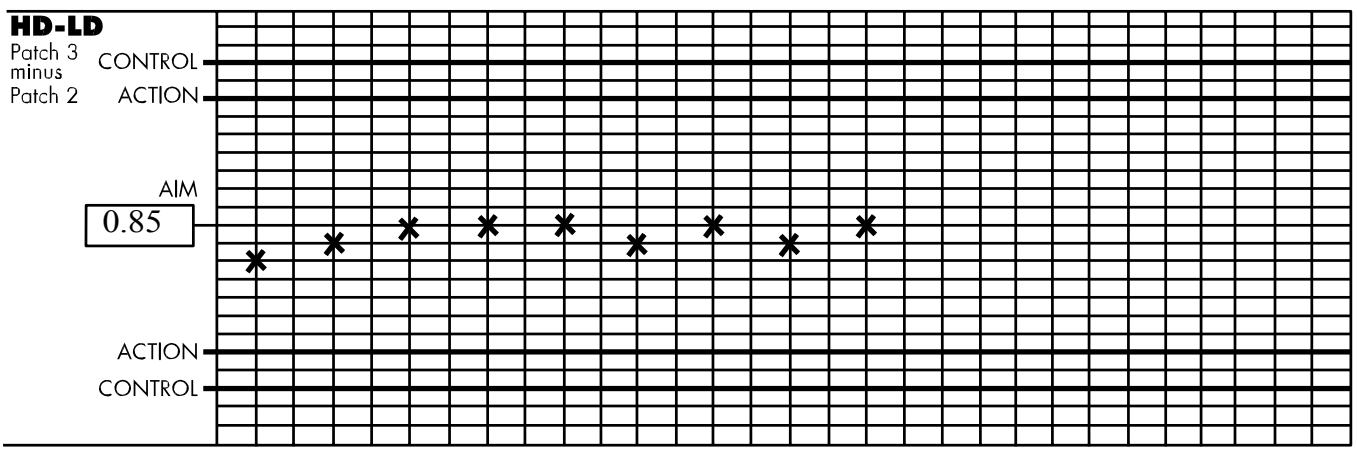
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | 1/12 | 2/12 | 3/12 | 3/12 | 4/12 | 5/12 | 8/12 | 8/12 | 9/12 | | | | | | |
| TIME | am | am | am | pm | am | am | am | pm | am | | | | | | |
| TEMPERATURE 26ºC | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | | | | | | |
| REPLENISHMENT RATES 12mls | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | | | | | | |
| DAILY THROUGHPUT | 24 | 30 | 10 | 20 | 40 | 2 | 7 | 12 | 21 | | | | | | |
| PH 9.52 | | | ok | | | | ok | | | | | | | | |
| SG 1.125 | | | ok | | | | ok | | | | | | | | |
| COMMENTS | monday | | | | new dev. rep | | monday | | | | | | | | |

EXAMPLE

**CONTROL STRIPS BATCH NUMBER** 75CFx2c07/02-27 (3837)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DMIN** Pth1 | 0.32 | 0.32 | 0.35 | 0.32 | 0.33 | 0.34 | 0.32 | 0.32 | 0.33 | | | | | | |



## BASIC LAB TECHNIQUES

### Safety

Always wear gloves, safety glasses and an overall or lab coat when handling and using processing chemicals.

Do not store and prepare food or drinks or eat, drink or smoke in areas where chemicals are being stored, prepared or used.

It is good practice to keep wet and dry areas separate in a lab. This clearly defines where you are likely to find chemicals and helps to stop chemical contamination spreading to other areas.

Photographic chemicals are not hazardous when used correctly and the specific health and safety recommendations for a chemical are followed. Basic rules of common sense and good housekeeping should be observed. Health and safety recommendations are always given on the packaging of each product, as a guide to safe handling and use.

### Making up solutions

Always read the instructions provided and follow all safety advice, many of the problems that occur with chemicals in labs can be avoided if the full instructions on the packaging are followed.

Store solutions you make in appropriate containers and label every solution container with the product name, its dilution, quantity and the date it was prepared. It is also good practice for the person who made up the chemical to mark the container with their name or initials.

As most water drawn from pressure mains is highly aerated, if it is possible it is advisable to leave mixed solutions to stand for a few minutes after mixing and before use.

### Powder chemicals

Always make up powder chemicals as packed, do not attempt to prepare smaller quantities by taking fractional parts of the powders. Powder chemicals mix best when they are added to water rather than if water is added to them. When mixing, sprinkle the powder close to the surface of the water and ensure there is good ventilation in the workroom. Do not breathe in chemical dust.

An automatic stirrer makes the job of stirring in the powder convenient and fast. They are particularly useful when preparing large volumes of solution as some powders can take over 15 minutes to dissolve with constant stirring.

With multi-part powders there is a correct order in which to dissolve the parts. Slowly sprinkle and stir in the contents of the first part to about three-quarters of the total volume of warm water. Sometimes, to cut down the time it takes to dissolve the powders, a higher temperature (up to 40°C/104°F) is recommended. When all of the chemicals have dissolved, gradually add the next part and stir gently until dissolved. Continue in this way until all the parts have dissolved and then add cold water to make up the total volume. If you are making up tank solutions allow the chemical to cool to the right working temperature before use.

It is important to dissolve the different parts of a chemical in the correct order because one of the parts will usually slow down the dissolving of another. For example, if you dissolve part B of ID–11 first, it will take a very long time to dissolve part A. The same applies if you try to dissolve both parts at the same time.

### Liquid chemicals

If you have to manually mix liquid chemicals the best way is to add water to the concentrate, it ensures the liquid concentrate does not splash out of the tank during mixing. However, for some chemicals it is safer to add the concentrate to water as some concentrates are strong acids (for example some systems cleaners) and it is dangerous to add water to strong acids.

Multi-part liquids, like powders, normally have a correct order for mixing. It is likely that a chemical will come out of solution if you mix the parts together before adding them to the water.

For example, if you mix the part A and B concentrates of ILFOTEC RT RAPID the mixture will turn milky. This is a chemical in part A coming out of solution, as it cannot tolerate the conditions in the part B concentrate. With time and a lot of stirring, this will go back into solution after the water is added. It is, however, very inconvenient and easily avoided by adding water to part A first.

## LAB EQUIPMENT - BASIC

Some basic equipment will make using and monitoring chemicals and the diagnosis of problems easier.

### Thermometer

A good quality liquid-in-glass thermometer is useful to check the calibration of any built-in temperature sensors. The advantage of a thermometer, as opposed to an electronic temperature probe, is that very little can go wrong with it.

### Containers/mixing vessels

These should be based on the volume of solution you needed for each of your processing solution. For a hand tank line, large stainless steel buckets are most useful. When preparing solutions from powder chemicals, large paddles or stirrers make preparing the solution much easier. For a large dip and dunk processor a mobile mixing unit is probably easiest. For very large volumes made from liquid concentrates automatic mixing units are very useful. Keeping a dedicated set of mixing vessels and utensils for making up the developer solution minimises the risk of problems due to cross contamination. Always thoroughly wash mixing vessels and utensils after use.

Use appropriately sized and calibrated measuring cylinders and vessels for the volume of solution being dispensed and prepared. For example it is easier and more accurate to measure 100ml of solution into a 100ml measuring cylinder than a 1000ml cylinder. For measuring large volumes of solution calibrated jugs and buckets are very useful.

## LAB EQUIPMENT - ADVANCED

These following items will make finding the cause of any problems easier.

### pH meter or pH sticks

A pH meter or the appropriate pH measurement sticks are used to measure how acidic or alkaline a solution is. A pH meter is useful to check that a developer or fixer has been made up correctly or that a working solution is being maintained at the correct pH for use. The pH of an ILFORD chemical is given in the appropriate product fact sheet available from our website at **www.ilfordphoto.com** or your local ILFORD selling company or distributor. Monitoring the pH of solutions regularly is a very useful thing to do as pH readings can help when tracing the cause of any process control variations and process problems. pH sticks are available in various ranges; those in the range from pH 7 to 10 are useful for most developers, whereas those in the range of pH 4 to pH7 are most useful for fixers.

### Hydrometer

A hydrometer measures the specific gravity (SG) of a solution. This is basically the weight of the solution compared to the same volume of water. For example, HYPAM diluted 1+4 has an SG of 1.08–1.09. This means that, as 1 litre of water weighs 1000g, 1 litre of diluted HYPAM will weigh between 1080g and 1090g.

A hydrometer with a range of 1.000 to 1.200 can be used to measure the specific gravity of a wide variety of processing solutions. Dilution errors or variations can normally be detected from SG measurements, however, the specific gravities of some black and white processing chemicals are close to that of water and this can make errors difficult to spot e.g. some working strength dilutions of ILFOTEC HC developer. As with pH, the specific gravity of an ILFORD chemical is given in the appropriate product fact sheet at **www.ilfordphoto.com** or is available from your local ILFORD selling company or distributor.

A wide range of fact sheets is available which describe and give guidance on using ILFORD products. Some products in this fact sheet might not be available in your country.

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