

## TECHNICAL INFORMATION

**ILFOTEC HC****HIGHLY CONCENTRATED FILM DEVELOPER AND REPLENISHER FOR ALL BLACK AND WHITE FILM PROCESSING APPLICATIONS**

ILFORD ILFOTEC HC is an economic, versatile, highly concentrated liquid developer for processing all general purpose black and white films. Using the appropriate dilution it can be used in all process systems including, dishes (trays), small tanks, deep tanks, dip and dunk (hanger) processors, rotary tube processors, continuous long leader processors, roller transport processors and short leader card processors.

To use ILFOTEC HC developer the concentrate is first diluted to make a stock solution. The developer stock solution must be further diluted for use. The degree of dilution will depend on the film to be processed and the method of processing. Do not use ILFOTEC HC developer as replenisher.

The following dilutions can be used and are recommend for applications where general purpose camera films are processed:

Developer Concentrate dilution	Application
1+11	for processing general purpose camera films in roller transport and short leader card processors
1+15	for the rapid development of general purpose camera films in small tanks, deep tanks and dishes (trays).
1+31	for processing most general purpose camera films in continuous processors, dip and dunk (hanger) processors, rotary tube processors, small tanks, deep tanks and dishes (trays).
1+47	for one shot small tank processing of general purpose cameras films.

The following dilutions can be used for specialist film processing applications:

Developer Concentrate dilution	Application
1+19 1+39 1+47	can be used for continuous tone graphic arts and copy films
1+79	for processing specialist graphic arts materials

For more information about processing these specialist materials consult the instructions provided by their manufacturers

For replenished and machine processing applications ILFOTEC HC is used in conjunction with a separate ILFORD ILFOTEC HC replenisher solution. To use ILFOTEC HC replenisher the concentrate is first diluted to make a stock solution. The replenisher stock solution must be further diluted for use. The degree of replenisher dilution will depend on the developer dilution being used. Do not use ILFOTEC HC replenisher as developer

Developer Concentrate dilution	Replenisher	Application
1+11	1+10	Roller transport and short leader card processors
1+15	1+7	Deep tank
1+31	1+11	Dip and dunk and continuous processors

ILFOTEC HC solutions have a long life and good resistance to contamination, reliably producing high quality, sharp results under a wide range of conditions. The recommended operating temperature range is 20–24°C, (68–75°F).

**MIXING**

**Note** Photographic chemicals are not hazardous when used correctly. It is recommended that gloves, eye protection and an apron or overall are worn when handling and mixing all chemicals. Always follow the specific health and safety recommendations on the chemical packaging. Photochemical material safety data sheets containing full details for the safe handling, disposal and transportation of ILFORD chemicals are available from ILFORD agents or directly from the ILFORD web site at. [www.ilfordphoto.com](http://www.ilfordphoto.com)

**Preparing stock developer**

It is very difficult to measure accurately small quantities of ILFOTEC HC concentrate. For this reason we recommend that the whole bottle of concentrate is diluted to form a stock solution, which is diluted further for use.

Stock developer is prepared by diluting the concentrate 1+3 with water.

Pour the contents of the 1 litre bottle of ILFOTEC HC concentrate into a mixing vessel. Measure out 3 litres of water. Rinse out the empty developer bottle with some of the dilution water and add this to the mixing vessel. Add the remaining dilution water to the mixing vessel to make up to a total volume of 4 litres of stock solution. Stir the stock solution thoroughly. If it is not required for immediate use store the stock solution in clean tightly capped bottles until needed.

**Preparing working strength developer solutions**

From the stock solution working strength ILFOTEC HC solutions can be mixed either manually or by using automatic solution mixing equipment. If automatic mixing equipment is used follow the equipment manufacturer’s recommendations and advice.

The table below gives the amount of water and developer stock solution required to make up 1 litre of working strength developer at each dilution.

Developer Concentrate dilution	Preparation	Solution quantity ml
1+11	1 part stock 2 parts water	333 667
1+15	1 part stock 3 parts water	250 750
1+19	1 part stock 4 parts water	200 800
1+31	1 part stock 7 parts water	125 875
1+39	1 part stock 9 parts water	100 900
1+47	1 part stock 11 parts water	84 916
1+79	1 part stock 19 parts water	50 950

1 litre = 33.81 US fluid ounces  
3.8 litres = 1 US gallon  
29.6ml = 1 US fluid ounce

**Preparing stock replenisher**

Stock replenisher solution is prepared by diluting the concentrate 1+7 with water.

The method of mixing is the same as that used for making the stock developer solution.

**Preparing working strength replenisher solutions**

The table below gives the amount of water and replenisher stock solution required to make up 1 litre of working strength replenisher at each dilution.

Replenisher Concentrate dilution	Preparation	Solution quantity ml
1+10	1 part concentrate 10 parts water	91 909
1+7	Use the stock solution	1000
1+11	2 parts stock 1 part water	666 334

Before mixing fresh batches of ILFOTEC HC developer and replenisher ensure that the developer and replenisher tanks, connecting solution lines and any mixing vessels are thoroughly rinsed and cleaned, particularly if it is being used for the first time. When making solutions ensure that the mixing vessel is large enough for the volume of solution to be mixed and stirred.

After filling a processor with any fresh tank solution, switch it on and allow it to get up to temperature and circulate the solutions. After the working temperature is reached leave it recirculating for at least 10 minutes to ensure the fresh chemicals are thoroughly mixed before attempting to process any film. Always replace the tank covers used on the process and replenishment solutions. The processor is now ready to use.

Wash out the mixing vessel.

**pH and specific gravity**

The following table gives the pH and specific gravity (SG) for fresh, working strength ILFOTEC HC developer and ILFOTEC HC replenisher. These figures were obtained under carefully controlled laboratory conditions and may differ slightly from measurements made by users in their own working areas. Users should make their own control measurements from their own accurately mixed fresh solutions for later comparison. Ideally a pH meter should be used to measure solution pH but if one is not available pH measurement sticks can be used. These are available in various pH ranges and those covering a range from pH 7 to pH 10 are sufficient. SG can be measured by using a hydrometer and one covering the range from 1.000 to 1.200 is useful for a wide range of photographic process solutions.

Developer dilution	pH	SG at 20°C
1+3 stock	9.20	1.065-1.070
1+11	9.10	1.020
1+15	9.05	1.015
1+19	9.00	1.013
1+31	8.98	1.006
1+39	8.97	1.005
1+47	8.95	1.002
1+79	8.90	—

Replenisher dilution	pH	SG at 20°C
1+7	9.10	1.030
1+10	9.10	1.020
1+11	9.10	1.015

**PROCESS SYSTEMS**

**Manual processing**

**Spiral tanks**

ILFOTEC HC can be used to process films in spiral tanks with a dilution of 1+15, 1+31 or 1+47 at the recommended temperature of 20°C (68°F). However, it can be used in the temperature range of 20–24°C (68–75°F) but the development times must be reduced for the higher temperatures. Care must be taken with the choice of dilution and temperature as the very short development times for some films may lead to uneven processing.

Before starting to process prepare the required volume of all the process solutions according to tank size and number of films to be processed together. The solution volume must be enough to cover all the spirals used. Check the temperature of all the process solutions and if necessary adjust them to be +/- 1°C (2°F) of the temperature being used.

Add the working strength developer to the processing tank. Tap the tank firmly on the work bench to dislodge any air bubbles which may be trapped in the processing spiral.

The following agitation is recommended for spiral tank processing with ILFORD chemicals. Invert the tank four times during the first 10 seconds. Repeat these four inversions during the first 10 seconds of each subsequent minute of development. At the end of each agitation sequence tap the tank firmly on the work bench to dislodge any air bubbles which may be trapped in the processing spiral. This method of agitation should also be used with the fixer.

Drain off the developer 10 seconds before the end of the development time. Immediately fill the tank with the next process solution.

**Dish (Tray) processing (Sheet film only)**

ILFOTEC HC can be used to process sheet film formats in dishes (trays) using either 1+15 or 1+31 dilution at the recommended temperature of 20°C (68°F) +/- 1°C (2°F). Higher temperatures are not recommended as the development times may become too short and lead to uneven processing.

Before starting to process prepare the required volume of all the process solutions according to dish (tray) size used and number of films to be processed. The solution volume must be enough to cover the sheet film completely during processing. Check the temperatures of all the process solutions and if necessary adjust them to be +/- 1°C (2°F) of the temperature being used.

When dish (tray) processing continuous agitation is used, immerse the film completely in the developer and gently rock the dish from side to side taking care to avoid any spillage. This method of agitation should be used for subsequent processing steps. Continuous agitation reduces the recommended development times by about 15%.

Remove the film from the dish (tray) 10 seconds before the end of the development time and allow developer to drain from its surface before placing in the stop bath.

### Deep tank processing

ILFOTEC HC can be used in deep tanks at either 1+15 or 1+31 dilution at the recommended process temperature of 20°C (68°F). However, it can be used in the temperature range of 20–24°C (68–75°F) but the development times must be reduced for the higher temperatures. Care must be taken with the choice of dilution and temperature as very short development times may lead to uneven processing.

Check the temperatures of all the process solutions and if necessary adjust them to be +/- 1°C (2°F) of the temperature being used.

### Manual agitation for deep tanks

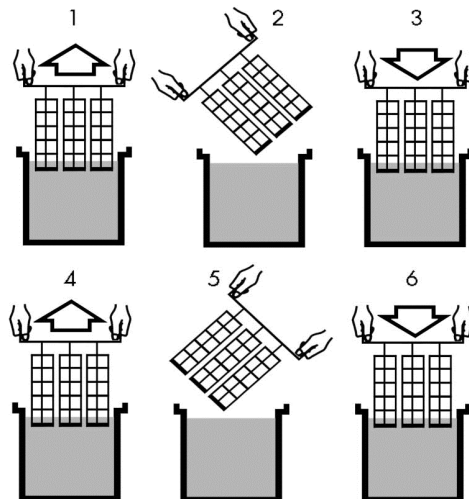
The following method of manual agitation is recommended with ILFOTEC HC in deep tanks.

Lower the processing rack into the tank and tap the rack on the edges of the tank to remove any air bubbles. Lift the rack out of the solution and return it immediately. Tap the rack again on the edge of the tank.

At the end of each minute, lift the rack out of the solution, tilt it to one side and return it to the tank. Repeat this another two times, alternating the direction of the tilt. Tap the rack on the edge of the tank after the three lifts.

The same agitation technique should be used with the other process solutions.

Ten seconds before the end of each processing step lift the rack out of the solution and drain for the remainder of the time.



Alternatively gas agitation can be used, (see below), but it is not recommended when processing films on spirals.

### Processors

#### Dip & Dunk processors

Replenished ILFOTEC HC can be used in dip & dunk (hanger) processors at 1+31 dilution, the recommended process temperature is 22°C (72°F).

#### Gas burst agitation for Dip & Dunk processors and deep tanks

If gas burst agitation is in use then nitrogen must be used to agitate the developer whereas air can be used for the stop bath, fixer and wash. Do not use air to agitate the developer solution. To set up gas burst agitation follow the equipment manufacturer's instructions, if none are given then as a starting point set the gas pressure to 0.3–0.9 bar (5–14 psi) and the agitation cycle to 2 seconds gas on 8 seconds gas off.

Alternatively a lower rate of agitation can be used of one gas burst every other second for eleven seconds in each minute but development times may need to be adjusted.

Care must be taken when using gas agitation as uneven processing may result with some equipment. Do not load the films too closely together as this will reduce the effect of the solution's agitation.

The same amount of agitation but with air can be used for the other process solutions.

Gas agitation of wetting agent solutions is not recommended as excessive foaming will occur.

### **Continuous long leader processors**

Replenished ILFOTEC HC 1+31 can be used in continuous long leader processors the recommended process temperature is 22°C (72°F). Agitation is given by the continuous movement of the film through the solutions and the action of the chemical recirculation systems.

### **ILFORD ILFOLAB FP40 and short leader film processors**

Replenished ILFOTEC HC 1+11 can be used in the ILFORD ILFOLAB FP40 and other short leader film processors. The recommended process temperature is 24°C (75°F). Agitation is given by the film passing through the developer and the processor's recirculation system.

The ILFOLAB FP40 film processor is an automatic short leader processor with daylight loading designed for processing black and white 35mm films. The ILFOLAB FP40 also has a wide range of optional accessories that make it able to process 120 and 220 roll film and long lengths of 16mm and 35mm film, 125 micron (0.005 inch) thick up to 30.5m (100 ft) and 75 micron (0.003 inch) thick to 61m (200 ft).

There are other short leader processors designed specifically for black and white film processing but some of those used are converted colour film processors. These machines operate in a wide temperature range and for black and white processing with ILFOTEC HC temperatures in the range of 22–24°C (72–75°F) can be used. The development times must be modified appropriately.

If other temperatures are used care must be taken as very short development times may lead to uneven processing.

### **Roller transport film processors**

Roller transport film processors for black and white film come in many different design configurations. Replenished ILFOTEC HC 1+11 is recommended for film roller transport processors when either short development times or high temperatures are needed. Typically the temperature used in a film roller transport processor is 22–30°C (72–86°F). The recommended process temperature for ILFOTEC HC 1+11 is 22–24°C (72–75°F). Appropriate modification of the development times must be used, care must be taken as very short development times may lead to uneven processing.

### **Rotary tube processors**

Rotary tube processors have very similar processing conditions to spiral tank processing by hand, except they process with small amounts of solution using continuous agitation and can be pre-programmed. For black and white processing ILFOTEC HC 1 + 31 can be used at 20°C (68°F).

Follow any guidance given by the processor manufacturer when adjusting process times for these types of processors. However, generally we do not recommend using a pre-rinse as it can lead to uneven development.

Without using a pre-rinse the given development times will need to be reduced by around 15% to compensate for the continuous agitation.

### **DEVELOPMENT TIMES**

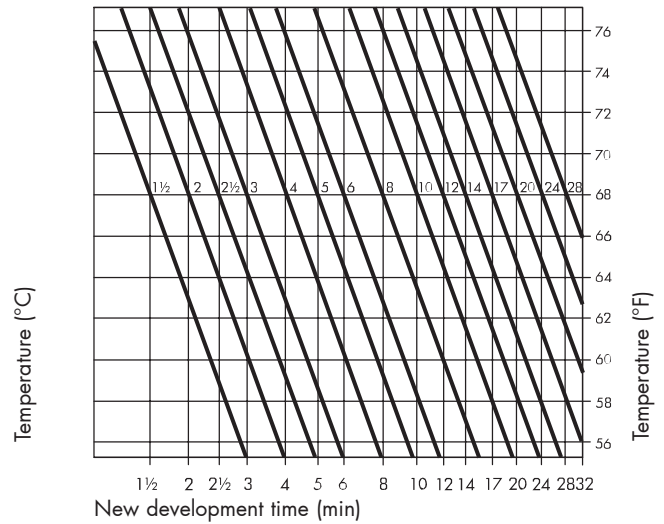
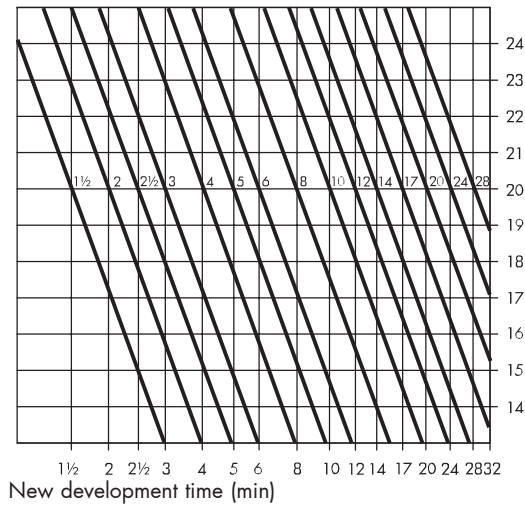
The tables of development times given here are an appropriate starting point for the ILFOTEC HC dilutions used for in general purpose camera film processing applications.

The development times are for films rated at their nominal EI rating and should produce negatives of normal contrast, the aim is for a Gbar of 0.62. However they are only a guide and may need to be adjusted to suit individual processing systems, working practices and preferences. Higher or lower contrast negatives may be preferred by some to suit their individual requirements, adjust the recommended development times until the desired contrast level is obtained.

In some processors the development time is controlled by the machine's speed. Please refer to the technical information of the machine's manufacturer to convert development time to machine speed.

Depending on dilution and application ILFOTEC HC can be used in the temperature range of 20–24°C (68–75°F). For processing at other temperatures increase the given development times by 10% for each 1°C/2°F drop in temperature and decrease the given development times by 10% for each 1°C/2°F rise in temperature. Alternatively use the time/temperature graphs below.

For example, if 4 minutes at 20°C/68°F is recommended, the time at 23°C/73°F will be 3 minutes and the time at 16°C/61°F will be 6 minutes.



**ILFORD FILMS**

	Meter setting	seconds	min:sec	min:sec	min:sec
		dilution	dilution	dilution	dilution
		1+11	1+15	1+31	1+47
		24°C(75°F)	20°C(68°F)	20°C(68°F)	20°C(68°F)
100 DELTA PROFESSIONAL	EI 50/18	55	-	5	5.30
	EI 100/21	70	-	6	7.30
	EI 200/24	110	-	8	10
DELTA 400 PROFESSIONAL	EI 200/24	-	-	5	8.30
	EI 320/26	-	4	-	-
	EI 400/27	-	-	7.30	11.30
	EI 800/30	-	5.30	10	17
	EI 1600/33	-	7.30	13.30	-
	EI 3200/36	-	13	-	-
DELTA 3200 PROFESSIONAL	EI 400/27	-	-	6	-
	EI 800/30	-	-	7.30	-
	EI 1600/33	-	5	9	-
	EI 3200/36	-	8	14.30	-
	EI 6400/39	-	13	-	-
PANF Plus	EI 25/15	50	-	-	-
	EI 50/18	65	-	4	5.30
FP4 Plus	EI 50/18	-	-	6	8
	EI 125/22	70	4	8	12
	EI 200 /24	-	5	9	-
HP5 Plus	EI 400/27	55	3.30	6.30	9
	EI 800/30	70	5	9.30	-
	EI 1600/33	90	7.30	14	-
	EI 3200/36	130	11	-	-
SFX 200	EI 200/24	-	5	9	11
	EI 400/27	-	7	13	-
	EI 800/30	-	10.30	19	-
ORTHO PLUS Pictorial Contrast	EI 80/20 Daylight				
	Normal	-	4	6	-
	High	-	5	8	-
	EI 40/17 Tungsten				
	Normal	-	4	6	-
High	-	5	8	-	

**NON ILFORD FILMS**

	Meter setting	seconds	min:sec	min:sec	min:sec
		dilution 1+11 24°C(75°)	dilution 1+15 20°C(68°F)	dilution 1+31 20°C(68°F)	dilution 1+47 20°C(68°F)
Kodak Tmax 100	EI 100/21	90	3.30	7.30	11
	EI 200/24	-	-	-	-
Kodak Tmax 400	EI 400/27	80	3.30	6.30	9
	EI 800/30	-	5	8	-
	EI 1600/33	-	-	8.30	-
	EI 3200/36	-	-	11	-
	EI 6400/39	-	-	13	-
Kodak Tmax 3200	EI 400/27	-	-	7.30	-
	EI 800/30	-	-	8	-
	EI 1600/33	-	-	9	-
	EI 3200/36	-	-	11	-
	EI 6400/39	-	-	14	-
Kodak Plus X	EI 125/22	-	3	4.30	9
Kodak Tri X	EI 400/27	-	3.30	6.30	-
	EI 800/30	-	5	-	-
	EI 1600/33	-	7	-	-
	EI 3200/36	-	-	-	-
Agfa APX 100	EI 100/21	-	4	7.30	-
Agfa APX 400	EI 400/27	-	3	6	-
	EI 800/30	-	-	-	-
	EI 1600/33	-	-	-	-
	EI 3200/36	-	-	-	-
Fuji 100 Acros	EI 80/20	-	-	4.30	-
Fuji Neopan 400	EI 400/27	-	4	6	8
	EI 800/30	-	-	8	-
	EI 1600/33	-	-	10	-
	EI 3200/36	-	-	-	-
Fuji Neopan 1600	EI 400/27	-	-	-	-
	EI 800/30	-	-	4.45	-
	EI 1600/33	-	3	7	10
	EI 3200/36	-	-	-	-

The development times for other manufacturers' films are a general guide. The specification of these products may have changed over time and as a result these development times may need to be adjusted. If necessary the given times should be adjusted to give the result required.



**STOP, FIX, WASH and RINSE**

For best results it is recommended that all process solutions are kept at the same temperature or at least within 5°C (9°F) of the developer temperature.

**Stop Bath**

After development it is recommended that films are rinsed in an acid stop bath such as ILFORD ILFOSTOP (with indicator dye) or ILFOSTOP PRO (without indicator dye). ILFOSTOP PRO is recommended for all machine processing applications. When tanks of process solutions are in use a stop bath immediately stops development and reduces carry over of excess developer into the fixer bath. This helps to maintain the activity and prolong the life of the fixer solution.

ILFORD Stop Bath	ILFOSTOP	ILFOSTOP PRO
Dilution	1+19	1+19
Temperature range	18–24°C (64–75°F)	18–24°C (64–75°F)
Time (seconds) at 20°C (68°F)	10	10
Capacity films/litre (unreplenished)	15 (135–36)	22 (135–36)

The process time given is the minimum required. Due to the configuration of some processing machines a longer stop bath time may be given automatically but this should not cause any process problems. The design of some processing machines means that a stop bath cannot be included, provided that the fixer activity is monitored and adequate fixer replenishment rates used there should be no process problems.

**Fix**

The recommended fixers, ILFORD RAPID FIXER and ILFORD HYPAM liquid fixers and ILFORD ILFOFIX II powder fixer, are non-hardening fixers.

ILFORD Fixer	ILFORD HYPAM & ILFORD RAPID FIXER	ILFORD ILFOFIX II
Dilution	1+4	stock
Temperature range	18–24°C (65–75°F)	18–24°C (65–75°F)
Time (mins) at 20°C (68°F)	2–5	4–8
Capacity films/litre (unreplenished)	24 (135–36)	24 (135–36)

The fixing time given is the minimum required. Due to the configuration of some processing machines a longer fixing time may be given automatically but this should not cause any process problems. ILFORD ILFOFIX II is not recommended for machine processing applications.

**Wash**

When a non-hardening fixer has been used wash the films in running water for 5–10 minutes. The water temperature should be above 5°C (41°F), ideally within 5°C (9°F) of the developer temperature.

For spiral tank use, when a non-hardening fixer has been used, the following method of washing is recommended. This method of washing is faster, uses less water yet still gives negatives suitable for long term storage.

After fixing, fill the spiral tank with water at the same temperature ±5°C (9°F) as the processing solutions and invert it five times. Drain the water away and refill. Invert the tank ten times. Once more drain the water away and refill. Invert the tank twenty times and drain the water away.

**Rinse**

For a final rinse ILFORD ILFOTOL wetting agent is recommended as it helps films to dry evenly. Start by using 5ml per litre of rinse water (1+ 200), however the amount of ILFOTOL used may need some adjustment depending on the local water quality, the type of processor and drying method. Too little or too much wetting agent can lead to uneven drying.

**FIX HARDENER**

ILFORD RAPID FIXER and ILFORD ILFOFIX II must not be used with fix hardeners as they are not compatible with them. If a fix hardener is required then only ILFORD HYPAM fixer can be used. Add ILFORD HYPAM HARDENER to HYPAM to turn it into a hardening fixer

Generally for most applications modern camera films are sufficiently hardened at manufacture. Additional hardening from a fixer hardener is not usually needed or recommended for deep tanks, rotary processors, dip and dunk machines and short leader processors, unless the processing temperature is above 30°C (86°F) or poor drying performance is being experienced. A fixer hardener may be needed when using roller transport film processors to minimise the risk of physical damage.

Using a fix hardener will require the recommended fix and wash times to be extended. Depending on the film and processing conditions the fix plus hardener time will be between 4 and 10 minutes and the subsequent wash time 10–20 minutes.



The amount of HYPAM HARDENER that can be added to the fixer is dependent on the film and process conditions used. In some processors the full amount of hardener cannot be used as the fix and wash times cannot be extended adequately. In these circumstances we recommend starting with the minimum amount of hardener to have some effect. This is around 3–6 mls of hardener per litre of working strength HYPAM used. This increases the film hardness slightly but has a negligible effect on the fix and wash efficiency. When fix and wash times are restricted the maximum amount of HYPAM HARDENER recommended is 10–20 mls of hardener per litre of working strength HYPAM used. This higher amount will give a definite increase to the hardness of the films processed and while fixing and washing efficiency are reduced the films will be adequately fixed and washed for most purposes.

When fix and wash times can be extended the maximum amount of HYPAM HARDENER needed to achieve fully hardened films is 1 part to 40 parts working strength HYPAM. i.e. 24 mls per litre.

**REPLENISHMENT**

For replenishment only use ILFOTEC HC replenisher at the dilution appropriate to the developer dilution. Do not use ILFOTEC HC developer as replenisher

The optimum developer replenishment rate for a particular process system can be found by using a process control system. For your processor please refer to the machine manufacturer’s technical information to calibrate it for replenishment.

The recommended replenishment rates for all dilutions of ILFOTEC HC replenisher are:-

Film Format	mls	US fluid oz
135-12	7	1/4
135-24	14	1/2
135-36	22	3/4
120	22	3/4
220	44	1 1/2
10.2x12.7cm(4x5")	6	1/4
12.7x17.8cm (5x7")	8	1/3
20.3x25.4cm (8x10")	22	3/4
6.5x9cm	3	1/10
9x12cm	7	1/4
10 x 15cm	7	1/4
13 x18cm	8	1/3

To give adequate replenishment to deep tanks, it may be necessary to remove some of the used developer from the developing tank so that the appropriate amount of replenisher can be added. Remove more developer than the amount of replenisher to be added. Add the replenisher to the tank and stir thoroughly and top up the solution to the correct level using some of the removed developer.

**REUSING DEVELOPER WITHOUT REPLENISHMENT**

ILFOTEC HC 1+15 and 1+31 working strength developer can be used in spiral tanks or deep tanks without replenishment to process either a number of films individually or multiple films in batches.

The table below gives the number of 135/36 or 120 roll films a litre of working strength ILFOTEC HC can process provided that the developer is reused.

	films/litre
ILFOTEC HC 1+15	10
ILFOTEC HC 1+31	5

As each film or batch of films is processed it releases halides and other byproducts into the developer that act as a restrainer on the development of subsequent films. For this reason development times will need some adjustment after each successive film or batch of films. To calculate the adjustment a tally must be kept of the number of films processed in the developer solution.

If a series of individual films is being developed in a spiral tank using 1 litre ILFOTEC HC 1+15, compensate for the loss of developer activity after developing the first film by increasing the development time 10% for each successive film, (see table below). This method of time adjustment relies on the used developer, (250 -300ml for one film), being poured back into the stock bottle and mixed with the fresh unused part of the developer before processing the next film. When using spiral tanks this helps to give more consistent results by reducing the risks of problems due to solution losses and the restraining effect of the byproducts.

ILFOTEC HC	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
1+15	1	2	3	4	5	10
1+31	1	2	3	4	5	nr

N = standard development time  
nr = not recommended

The developer should be discarded either when the theoretical capacity of the solution volume has been reached or the development times have become too long to be practical

When larger quantities of developer are in use either for spiral processing or in deep tanks increase the number of films that can be processed proportionally with the volume of stock developer, e.g. if 5 litres of ILFOTEC HC 1+15 are being used then increase the development times by 10% after processing every batch of 5 films. When films are being processed in small batches the following tables show for some common tank sizes the number of films that can be processed before each 10% increase in development time.

**ILFOTEC HC 1+15**

tank volume litres	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
5	1-5	6-10	11-15	16-20	21-25	46-50
13.5	1-13	14-27	28-40	41-54	55-68	122-135
25	1-25	26-50	51-75	76-100	101-125	230-250

N = standard development time

**ILFOTEC HC 1+31**

tank volume litres	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
5	1-5	6-10	11-15	16-20	21-25	nr
13.5	1-13	14-27	28-40	41-54	55-68	nr
25	1-25	26-50	51-75	76-100	101-125	nr

N = standard development time

nr = not recommended

When batches containing a large number of films are processed or when the number of films in each successive batch varies the table above needs some interpretation. No matter how many films are in the first batch it will always receive the standard development time for the film (N). However, the number of films in the first batch will dictate the development time correction for the next batch of films. Thereafter the running total of films already processed by the developer indicates the appropriate increase for the third, fourth, fifth batches, etc.

For example, if a 13.5 litre deep tank is in use and there are five batches of film to process consisting of the following number of films 21, 21, 10, 17 and 5. The table below gives the appropriate time correction for each batch.

Batch	1	2	3	4	5
number of films	21	21	10	17	5
total of films in the previous batches	0	21	42	52	69
development time for each batch	N	N+10%	N+30%	N+30%	N+50%

Reusing stock developer solutions can make more economical use of them but it is not without its drawbacks particularly when small volumes are being used. More inconsistencies will be seen by reusing a developer than by using a fresh developer solution on each occasion or using a replenished system. The time compensation for reuse can only be an approximation to cover a range of circumstances such as film and negative types, solution losses and its age, etc. For example, if due to the subject matter the negatives are relatively clear when developed, then little of the developing agents will have been used in processing them. At the other extreme if the negatives are well blackened after development then more of the developing agent will have been used.

Overall reusing developer lowers image quality slightly and increases the risk of physical damage. As the developer oxidises with reuse and storage, the risk of contamination is increased, precipitates may be formed and tiny particles of emulsion from the films processed previously may be held in suspension. In addition there is also a risk of miss counting the number of films that have been processed by a batch of developer.

“One-shot” processing in spiral tanks using the 1+47 developer dilution or using a replenished processing system for deep tanks eliminates or greatly reduces the problems associated with developer reuse and are recommended as better alternatives.

We do not recommended reusing diluted developers, 1+47 , always use fresh solutions on each occasion.

We do not recommend push processing using reused developers.

**PROCESSING WITH REPLENISHED DEVELOPER**

**The effect of use on a replenished developer system**

The reaction that takes place during film development releases by-products (halides) into the developer, uses up developing agents and changes the developer’s pH. These combine to reduce the activity of the developer and without replenishment it would gradually cease to function adequately and eventually become exhausted.

Replenishment has two key functions. It replaces the active ingredients used during development and dilutes the by-products that have been formed.

A replenished developer is said to be fully “seasoned” when the addition of the replenisher compensates exactly for the new by-products produced by development. At this point the concentration of halides and active ingredients have reached an equilibrium or steady state. It is maintaining this equilibrium that gives a machine developer performance consistency.

Provided that the developer is used regularly, replenishment continues and all other factors remain the same, i.e. the concentration of the active ingredients, the by-products, etc., then the developer should perform consistently for a long period of time.

**Fresh versus seasoned developer and the function of the replenisher solution.**

A tank of freshly made working strength developer is usually more active than a tank of “seasoned” replenished developer. If the same process time is used in both cases then a small loss in film speed and contrast will be seen using the seasoned developer. The change in performance from fresh to seasoned is gradual with each film processed until the equilibrium point is reached.

In a replenished process system with separate developer and replenisher solutions, the replenisher is formulated to be more active than the developer. The addition of this more active solution minimises the performance difference between the fresh and seasoned condition.

The time taken to reach equilibrium from fresh depends on the developer and replenisher formula, tank size, the amount of film processed and their type and replenishment rate. When ILFOTEC HC Developer is used with ILFOTEC HC Replenisher and replenished at the recommended rate the difference in performance between fresh and seasoned developer is negligible so there is no appreciable “seasoning” period and no adjustments to the given development times are required.

**PROCESS CONTROL**

To process film to a consistent standard, it is essential to use a method to monitor the condition and activity of the process solutions. Valuable aids ensuring consistent film processing quality are ILFORD FP4 Plus CONTROL STRIPS and the ILFORD FILM PROCESS CONTROL MANUAL (FPC manual).

FP4 Plus CONTROL STRIPS are supplied pre-exposed on to a 30.5m (100 ft) roll of 35mm film. Each strip consists of four density patches, Dmin, LD, HD and Dmax, when needed individual strips are cut from the roll for process monitoring.

The FPC manual contains information about process control methods and equipment and a fault finding and correction guide. It also contains useful tools such as process control charts and user data record sheets.

**Process control method, aims and tolerances**

FP4 Plus CONTROL STRIPS should be regularly processed at the development time usually used for FP4 Plus film. The frequency of processing control strips is for the user to decide based on your workload and work patterns but we suggest that at least one control strip is processed per working session. After processing measure the density of the patches using a calibrated transmission densitometer and record the results for Dmin, LD and HD-LD on a process control chart. A visual assessment of density cannot be relied upon.

Before starting process control it is important to ensure that the developer is at equilibrium and producing satisfactory negatives. If it is then process three FP4 Plus CONTROL STRIPS, measure and record the density patches on each one and calculate HD-LD. Average the results for Dmin, LD and HD-LD and use these as your aim values for future measurements. The process is considered in control provided that the measurements from subsequent strips are within +/-0.06 units of the established aim values.

The following FP4 Plus CONTROL STRIP density patch values are typical for seasoned ILFOTEC HC in good condition. They are given only as a guide and are not absolute values that must be achieved, do not attempt to adjust your process to obtain identical values. The most important thing is that the quality of the negatives produced is satisfactory.

	Seasoned
Dmin	0.30
LD	0.45
HD-LD	0.80

**Dealing with process variations**

Properly replenished ILFOTEC HC developer in regular use should have a long tank life. Any large process variations seen are most likely to be caused by an external change. If a sudden and significant process variation has occurred it is most important to identify the cause, so that the appropriate corrective action can be taken.

**Identifying a problem**

First, look for the obvious. The cause of the process change may be something visible such as low solution levels, blocked/leaking pipes, no recirculation, poor agitation, etc. Check the solution temperatures, SG and pH as well as gas pressure and recirculation. Run the processor with some test films and check that it triggers all the correct machine functions, e.g. agitation, replenishment, etc.

Check for any obvious sign of developer contamination e.g. cloudiness of the developer or an unusual odour.

Check the machine settings, e.g. temperatures, development times and replenishment rates as they may have been changed from normal.

**Regaining control of the process** Once the cause of the problem has been found and corrected then some action will probably be needed to get the process back within limits. It might happen automatically, for example if the temperature has been returned to the correct setting. If the problem was caused by low replenishment then removing a few litres of developer and replacing it with replenisher may bring the process back in control. In the extreme case to get back inside the limits may need all of the developer solution replacing with fresh developer.

If the reason for poor performance is contamination of the developer by stop bath or fixer then remove all the developer, flush out pumps and pipes, clean the tank and change the solution filter before replacing with a fresh solution.

**WORKING SOLUTION LIFE**

The life of a solution in a replenished system is dependent on film throughput, replenishment rates, processing temperature and film types. In roller transport, dip and dunk (hanger), short leader card and continuous processors correctly replenished ILFOTEC HC may last for quite a long time in the process tank. The only sure way of always knowing that the activity of the developer is adequate is to use a process control system. As a general guide for machine processing replenished ILFOTEC HC developer should be replaced after 6–12 months in the process tank.

For deep tank processing replenished ILFOTEC HC developer should be replaced when the amount of replenisher used is equal to the original volume of developer in the processing tank. For example if using a replenished 15 litre deep tank replace the developer when 15 litres of replenisher has been added. Alternatively the developer should be discarded after 1 month if this is sooner.

The table below gives the solution life in months of ILFOTEC HC developer working strength solutions stored in cool conditions, 5–20°C (41–68°F)

Developer concentrate dilution	Full bottles	Half full bottles	Tank with floating lid
1+11	6	2	1
1+15	6	2	1
1+31	3	1	1
1+19	6	2	na
1+39	2	1	na
1+47	2	1	na
1+79	–do not store–		na

The table below gives the solution life in months of ILFOTEC HC replenisher working strength solutions stored in cool conditions, 5–20°C (41–68°F)

Replenisher concentrate dilution	Full bottles	Half full bottles	Tank with floating lid
1+7	6	2	1
1+10	6	2	1
1+11	6	2	1

**STORAGE**

Full, unopened bottles of ILFOTEC HC concentrates stored in cool conditions, 5–20°C (41–68°F), will keep indefinitely. Once opened use completely to make stock solutions.

If stored in cool conditions, 5–20°C (41–68°F), ILFOTEC HC stock solutions will keep for up to :-  
6 months in full tightly capped bottles  
2 months in half full bottles.

**AVAILABILITY AND CAPACITY** ILFOTEC

HC developer is available in 1 litre bottles of concentrate that makes into 4 litres of stock solution. The table below summarises the total volume of working strength developer that can be got from 1 litre of concentrate for each dilution.

1 litre of developer concentrate at dilution	Volume of working strength developer	Capacity 135/36 film without replenishment or re-use	Capacity 135/36 film with replenishment
1+11	12	–	600
1+15	16	160	800
1+31	32	160	1600
1+19	20	na	na
1+39	40	na	na
1+47	48	na	na
1+79	80	na	na

ILFOTEC HC replenisher is available in 1 litre bottles of concentrate that makes into 8 litres of stock solution. The table below summarises the total volume of working strength replenisher that can be got from 1 litre of concentrate for each of the dilutions used.

1 litre of replenisher concentrate at dilution	Volume of working strength replenisher (litres)	135/36 films replenished per litre of concentrate
1+7	8	363
1+10	11	500
1+11	12	545

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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