TECHNICAL INFORMATION

ILFOTEC HC FILM DEVELOPER

HIGHLY CONCENTRATED FILM DEVELOPER 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 whitefilms. 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.
Specialist Applications	
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.

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

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	333
	2 Parts Water	667
1+15	1 Part Stock	250
	3 Parts Water	750
1+19	1 Part Stock	200
	4 Parts Water	800
1+31	1 Part Stock	125
	7 Parts Water	875
1+39	1 Part Stock	100
	9 Parts Water	900
1+47	1 Part Stock	84
	11 Parts Water	916
1+79	1 Part Stock	50
	19 Parts Water	950

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

Before mixing fresh batches of ILFOTEC HC developer ensure that the developer tank, 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.

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. 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 Concentrate Dilution	pH	Solution Quantity (ml)
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	-

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

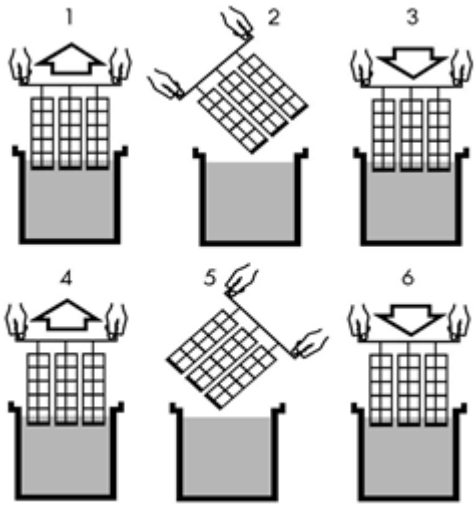
The following method of manual agitation is recommended with ILFOTEC HC in deep tanks.

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.



Gas burst agitation for Dip & Dunk processors and deep tanks

If gas burst agitation is in used, 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

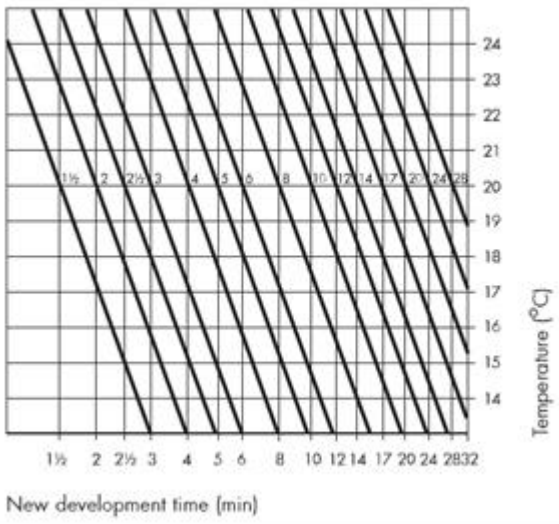
The tables of development times given here are an appropriate starting point for the ILFOTEC HC dilutions used for in general purpose camera film processing applications.

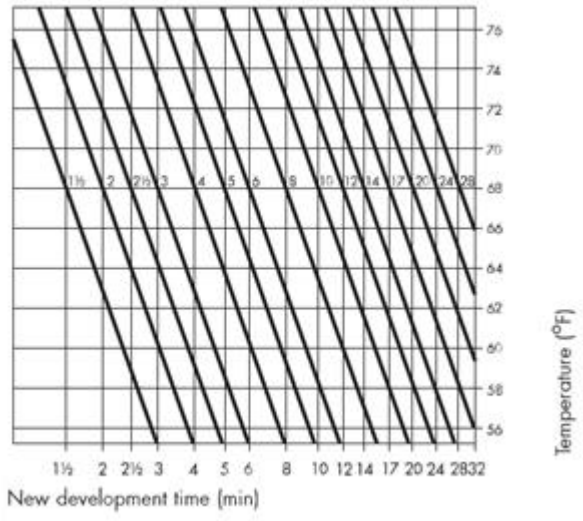
The development times are for films rated at their nominal EI rating and should produce negatives of normal contrast; the aim is for a Gbar of 0.62. However, they are only a guide and may need to be adjusted to suit individual processing systems, working practices and preferences. Higher or lower contrast 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 & KENTMERE FILMS

	Meter setting	min:sec dilution 1+11 24°C (75°F)	min:sec dilution 1+15 20°C (68°F)	min:sec dilution 1+31 20°C (68°F)	min:sec dilution 1+47 20°C (68°F)
100 DELTA PROFESSIONAL	EI 50/18	0:55	–	5:00	5:30
	EI 100/21	1:10	–	6:00	7:30
	EI 200/24	1:50	–	8:00	10:00
DELTA 400 PROFESSIONAL	EI 200/24	–	–	5:00	8:30
	EI 320/26	–	4:00	–	–
	EI 400/27	–	–	7:30	11:30
	EI 800/30	–	5:30	10:00	17:00
	EI 1600/33	–	7:30	13:30	–
	EI 3200/36	–	13:00	–	–
DELTA 3200 PROFESSIONAL	EI 400/27	–	–	6:00	–
	EI 800/30	–	–	7:30	–
	EI 1600/33	–	5:00	9:00	–
	EI 3200/36	–	8:00	14:30	–
	EI 6400/39	–	13:00	–	–
PANF Plus	EI 25/15	0:50	–	–	–
	EI 50/18	1:05	–	4:00	5:30
FP4 Plus	EI 50/18	–	–	6:00	8:00
	EI 125/22	1:10	4:00	8:00	12:00
	EI 200 /24	–	5:00	9:00	–
HP5 Plus	EI 400/27	0:55	3:30	6:30	9:00
	EI 800/30	1:10	5:00	9:30	–
	EI 1600/33	1:30	7:30	14:00	–
	EI 3200/36	2:10	11:00	–	–
SFX 200	EI 200/24	–	5:00	9:00	11:00
	EI 400/27	–	7:00	13:00	–
	EI 800/30	–	10:30	19:00	–
ORTHO PLUS Pictorial Contrast	EI 80/20 Daylight				
	Normal	–	4:00	6:00	–
	High	–	5:00	8:00	–
	EI 40/17 Tungsten				
	Normal	–	4:00	6:00	–
	High	–	5:00	8:00	–
Kentmere Pan100	100/21		4:00	5:00	
	200/24		5:00	6:30	
Kentmere Pan400	200/24				
	400/27		4:30	8:00	
	800/30		6:30	12:30	

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 the film can be rinsed in water, but we recommend that an acid stop bath is used such as ILFORD ILFOSTOP (with indicator dye). ILFOSTOP is also recommended for all machine processing applications. When tanks or dishes (trays) 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 ILFOSTOP	
Dilution	1+19
Temperature Range	18–24°C (64–75°F)
Time (sec) at 20°C (68°F)	10
Capacity (films per litre, unreplenished)	15x (135-36)

The process time given is the minimum required, if necessary, a longer time may be used and should not cause any process problems provided it is not excessive

Fix
The recommended fixers are ILFORD RAPID FIXER or ILFORD HYPAM FIXER.

Wash
Wash the films in running water for 5–10 minutes at a temperature within 5°C (9°F) of the process temperature. Or see note below for greater economy when using spiral tanks.

ILFORD RAPID OR HYPAM FIXERS	
Dilution	1+4
Temperature Range	18–24°C (64–75°F)
Time (mins) at 20°C (68°F)	2-5
Capacity (films per litre, unreplenished)	24x (135-36)

Note: For spiral tank use, 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. Finally, invert the tank twenty times and drain the water away.

Rinse
For a final rinse use ILFORD ILFOTOL wetting agent added to water, it helps the film to dry rapidly and 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 and drying method. Too little or too much wetting agent can lead to uneven drying. Remove excess rinse solution from the film before drying.

Drying
To avoid drying marks, use a clean squeegee or chamois cloth to wipe FP4 Plus film before hanging it to dry. Dry FP4 Plus at 30–40°C/86-104°F in a drying cabinet or at room temperature in a clean dust-free area.

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 several 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.

1L 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 Vol (L)	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 Vol (L)	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 recommend reusing diluted developers, 1+47, always use fresh solutions on each occasion.
We do not recommend push processing using reused developers.

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 made 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 re-use	Capacity 135/36 film With re-use
1+11	12	–	600
1+15	16	160	800
1+31	32	160	1600
1+19	20	N/A	N/A
1+39	40	N/A	N/A
1+47	48	N/A	N/A
1+79	80	N/A	N/A

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

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