

TECHNICAL INFORMATION

ILFOTEC DD-X, ILFOTEC LC29 AND ILFOSOL S FILM DEVELOPERS

LIQUID CONCENTRATE DEVELOPERS FOR LOW VOLUME BLACK AND WHITE FILM PROCESSING IN SPIRAL TANKS, DISHES/TRAYS AND ROTARY PROCESSORS WITHOUT REPLENISHMENT

ILFORD ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S are a range of liquid concentrate film developers formulated to exploit the full potential of conventional black and white film emulsions in all formats. They enable professionals and amateurs to develop small quantities of ILFORD and other films with ease and convenience. Their versatility allows for the optimisation of individual film speed, quality and economy while performing consistently throughout their long working lives.

ILFORD ILFOTEC DD-X

ILFORD ILFOTEC DD-X is an excellent fine grain developer which gives full film speed. It produces negatives which are easy to print. Correctly exposed negatives developed in ILFOTEC DD-X have a full range of tones, with depth in the shadows, a smooth transition through the mid-tones and bright detailed highlights.

ILFOTEC DD-X is designed to complement the features of all ILFORD films, especially the range of ILFORD DELTA PROFESSIONAL films. In particular it is recommended for use with DELTA 3200 PROFESSIONAL film rates at EI 3200/36. It also gives excellent results when used with quality black and white films from other manufacturers.

ILFOTEC DD-X ensures a good balance of fine grain, sharpness and tonal rendition producing negatives which allow a high degree of enlargement. In addition it is highly recommended when fast films need to be push processed such as HP5 Plus, DELTA 400 PROFESSIONAL, DELTA 3200 PROFESSIONAL and SFX200.

ILFOTEC DD-X is supplied as a liquid concentrate diluted 1+4 for one-shot use when the highest image quality is required. However, for greater economy it can be reused but image quality will be reduced slightly.

ILFORD ILFOTEC LC29

ILFORD ILFOTEC LC29 is a high dilution liquid concentrate black and white film developer that is flexible and economic to use. It is based on the technology used in ILFORD ILFOTEC HC developer but is formulated to be an easy to pour liquid for small volume film processing.

ILFOTEC LC29 is designed to complement the features of all ILFORD films giving fine grain negatives with good sharpness characteristics and image quality. It also gives excellent results when used with quality black and white films from other manufacturers.

With ILFOTEC LC29 there is a choice of dilution – 1+29, 1+19 and 1+9 – and the option for either one-shot processing or for greater economy to reuse the diluted developer solution during one working session.

ILFORD ILFOSOL S

ILFORD ILFOSOL S is a general purpose liquid concentrate black and white film developer. It is particularly suited to developing medium and slow speed films such as PANF Plus, FP4 Plus and 100 DELTA PROFESSIONAL.

ILFOSOL S gives fine grain and good sharpness with full film speed. Dilute it immediately before use and discard directly after development.

ILFOSOL S is supplied as a liquid concentrate normally diluted 1+9 for one-shot use. For greater economy it can be used with many films at a higher dilution of 1+14 with only a small trade off in image quality.

Mixing instructions

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

Determine first either the tank size being used or the number of films to be processed and measure out the appropriate quantity of concentrate. Always use the smallest measuring cylinder available: it is easier to measure 10ml accurately in a 50ml cylinder than in a 500ml cylinder.

Add the concentrate to the mixing vessel. A large measuring jug is a good mixing vessel as it provides a check on the total quantity of solution mixed. Rinse out the measuring cylinder used for the concentrate into the mixing vessel.

Finally add hot and cold water to make up the final volume at the desired temperature and stir thoroughly.

As most water drawn from pressure mains is highly aerated, we advise that users draw off the water they need and leave it to stand for a few minutes before using it to make up developers.

Thoroughly wash all utensils, measuring and mixing vessels after use. Do not contaminate developer solutions with either stop bath or fixer solutions.

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Table of Dilutions

The following table gives a list of common spiral tank sizes cross referenced with the amount of liquid concentrate and water required to fill the tank.

Tank size ml	1+4	1+9	Dilution 1+14 concentrate/water	1+19	1+29
100	20 / 80	10 / 90	7 / 93	5 / 95	3 / 97
150	30 / 120	15 / 135	10 / 140	8 / 142	5 / 145
200	40 / 160	20 / 180	13 / 187	10 / 190	7 / 193
250	50 / 200	25 / 225	17 / 233	13 / 237	8 / 242
300	60 / 240	30 / 270	20 / 280	15 / 285	10 / 290
350	70 / 280	35 / 315	23 / 327	18 / 332	12 / 338
400	80 / 320	40 / 360	27 / 373	20 / 380	13 / 387
450	90 / 360	45 / 405	30 / 420	23 / 427	15 / 435
500	100 / 400	50 / 450	33 / 467	25 / 475	17 / 483
600	120 / 480	60 / 540	40 / 560	30 / 570	20 / 580
700	140 / 560	70 / 630	47 / 653	35 / 665	23 / 677
800	160 / 640	80 / 720	53 / 747	40 / 760	27 / 773
900	180 / 720	90 / 810	60 / 840	45 / 855	30 / 870
1,000	200 / 800	100 / 900	67 / 933	50 / 950	33 / 967
2,000	400 / 1600	200 / 1800	133 / 1867	100 / 1900	67 / 1993

1 litre = 33.81 US fluid ounces

3.8 litre = 1 US gallon

29.6 ml = 1 US fluid ounce

Note

We advise not to use amounts of concentrate less than 10ml when mixing working strength solutions as it is difficult to measure accurately such small quantities with a measuring cylinder. If it is necessary to measure out very small quantities use a graduated pipette.

pH and specific gravity

The following table gives the pH and specific gravity (SG) for fresh solutions of ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developers. 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 pH7 to pH10 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/68°F
ILFOTEC DD-X	1+4	8.45 - 8.55	1.070
ILFOTEC LC29	1+9	8.90 - 9.00	1.015
	1+19		1.006
	1+29		1.002
ILFOSOL S	1+9	9.75 - 9.85	1.005
	1+14		1.002

PROCESS SYSTEMS**Manual processing****Spiral tanks**

ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developers can all be used to process films in spiral tanks using the recommended dilutions. The recommended developing temperature is 20°C (68°F). They can be used in the temperature range of 20–24°C (68–75°F) but the recommended development times must be reduced if higher temperatures are used. Care must be taken with the choice of dilution and temperature as very short development times with some films may lead to uneven processing

Before starting to process prepare the appropriate volume of all the required 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 adjust them to be +/- 1°C (2°F) of the temperature being used.

Add the 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 DD-X, ILFOTEC LC29 and ILFOSOL S developers can all be used to process sheet film formats in dishes (trays) 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 require 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 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 is used for all 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 it the stop bath.

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. ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developers can all be used to process films in rotary processors using the recommended dilutions 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.

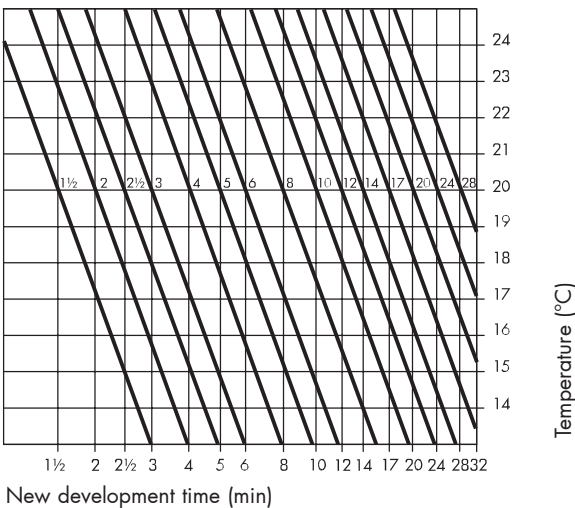
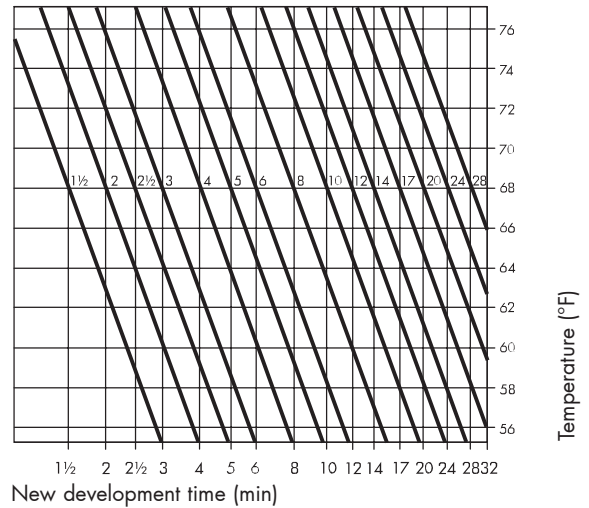
DEVELOPMENT TIMES

The table of development times given here gives an appropriate starting point for ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developers when general purpose black and white camera films are being developed in spiral tanks with intermittent agitation.

The development times are for films rated at an appropriate EI rating for each developer and should produce negatives of normal contrast, typically around 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.

ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developers 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 drop in temperature and decrease the given development times by 10% for each 1°C 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.



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ILFORD films

Developer time in min: sec	ILFOTEC DD-X			ILFOTEC LC29			ILFOSOL S	
	Dilution	1+4	1+4	1+9	1+19	1+29	1+9	1+14
Temperature	20°C/68°F		24°C/75°F	20°C/68°F			20°C/68°F	
Meter setting								
100 DELTA PROFESSIONAL	EI 50/18	9:30	7	–	5	5:30	4:30	6:30
	EI 100/21	12	9	–	6	7:30	6	10
	EI 200/24	14	11	–	8	10	–	–
DELTA 400 PROFESSIONAL	EI 200/24	6	4:30	–	5	8:30	6:30	10
	EI 320/26	–	–	4	–	–	–	–
	EI 400/27	8	5:30	–	7:30	11:30	9	13
	EI 500/28	9:30	7	–	–	–	–	–
	EI 800/30	10:30	7:30	5:30	10	17	14	–
	EI 1600/33	13:30	9	7:30	13:30	–	–	–
	EI 3200/36	18	13	13	–	–	–	–
DELTA 3200 PROFESSIONAL	EI 400/27	6	–	–	6	–	6:30	–
	EI 800/30	7	5	–	7:30	–	8	–
	EI 1600/33	8	6	5	9	–	10:30	–
	EI 3200/36	9:30	7	8	14:30	–	13	–
	EI 6400 /39	12:30	9	13	–	–	–	–
	EI 12500/42	17	12	–	–	–	–	–
PANF Plus	EI 25/15	7	4	–	–	–	–	–
	EI 50/18	8	5	–	4	5:30	4	6
FP4 Plus	EI 50/18	8	6	–	6	8	–	7:30
	EI 125/22	10	8	4	8	12	6:30	9:30
	EI 200 /24	12	10	5	9	–	7:30	–
HP5 Plus	EI 400/27	9	7	–	6:30	9	7	9:30
	EI 800/30	10	8	5	9:30	–	8:30	14
	EI 1600/33	13	10	7:30	14	–	14	–
	EI 3200/36	20	14:30	11	–	–	–	–
SFX200	EI 200/24	10	7	5	9	11	9:30	13
	EI 400/27	14	10	7	13	–	11:30	19
	EI 800/30	–	–	10:30	19	–	19	–
ORTHO PLUS Pictorial Contrast	EI 80/20 Daylight	–	–	–	–	–	–	–
	Normal	6:30	–	4	6	–	4:30	–
	High	9	–	5	8	–	6	–
	EI 40/17 Tungsten	–	–	–	–	–	–	–
	Normal	6:30	–	4	6	–	4:30	–
	High	9	–	5	8	–	6	–

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Non ILFORD films

Developer time in min: sec	ILFOTEC DD-X		ILFOTEC LC29			ILFOSOL S		
	1+4	1+4	1+9	1+19	1+29	1+9	1+14	
Dilution	20°C/68°F		24°C/75°F		20°C/68°F		20°C/68°F	
Temperature	Meter setting							
Kodak Tmax 100	EI 100/21	7	5	3:30	7:30	11	8:30	16
	EI 200/24	9	7	-	-	-	-	-
Kodak Tmax 400	EI 200/24	7	5	-	-	-	-	-
	EI 400/27	8	6	3:30	6:30	9	7:30	14
	EI 800/30	10	8.00	5	8	-	-	-
	EI 1600/33	13	10	-	8:30	-	-	-
Kodak Tmax 3200	EI 800/30	7:30	6.00	-	-	-	-	-
	EI 1600/33	9	7:30	-	8	-	-	-
	EI 3200/36	11	9	-	11	-	17:30	-
	EI 6400/39	15	12	-	13	-	-	-
Kodak Plus X	EI 64/19	5	-	-	-	-	-	-
	EI 125/22	6	4:30	3:30	5:30	9	7	12:30
	EI 200/24	8	6	-	-	-	-	-
Kodak Tri X	EI 200/24	6:30	4:30	-	-	-	-	-
	EI 400/27	8	6	3:30	6:30	-	10	-
	EI 800/30	10	8	5.00	-	-	-	-
	EI 1600/33	14	11	7	-	-	-	-
Agfa APX 100	EI 50/18	6	4	-	-	-	-	-
	EI 100/21	7	5	4	7:30	11	7	11
	EI 200/24	8	6:30	-	-	-	-	-
Agfa APX 400	EI 320/26	10	6:30	-	-	-	-	-
	EI 400/27	12	8	3	6	-	9	-
	EI 500/28	15	12	-	-	-	-	-
Fuji 100 Acros	EI 80/20	-	-	-	4:30	-	-	-
	EI 100/21	-	-	-	-	-	-	-
Fuji Neopan 400	EI 400/27	7	5	4	6	8	6:30	10
	EI 800/30	10	8	-	-	-	-	-
	EI 1600/33	-	-	-	-	-	-	-
	EI 3200/36	-	-	-	-	-	-	-
Fuji Neopan 1600	EI 400/27	-	-	-	-	-	-	-
	EI 800/30	4:30	-	-	-	-	-	-
	EI 1600/33	5	3:30	3	7	10	-	-
	EI 3200/36	9	6	-	-	-	-	-

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

When using "one-shot" processing in small spiral tanks a water rinse can substitute for a stop bath. After development film can be rinsed in water but we recommend that an acid stop bath is used such as ILFORD ILFOSTOP (with indicator dye) or ILFOSTOP PRO (without indicator dye). When deep 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 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 x 135–36	22 x 135–36

The process time given for the stop bath 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 ILFORD RAPID FIXER and ILFORD HYPAM liquid fixers and ILFORD ILFOFIX II powder fixer, are non-hardening fixers.

ILFORD Fixer	ILFORD RAPID FIXER & ILFORD HYPAM	ILFORD ILFOFIX II
Dilution	1+4	stock
Temperature range	18–24°C (64–75°F)	18–24°C (64–75°F)
Time (minutes) at 20°C (68°F)	2–5	4–8
Capacity - films / litre (unreplenished)	24 x 135–36	24 x 135–36

Wash

When a non-hardening fixer has been used wash the films in running water for 5–10 minutes at a temperature within 5°C (9°F) of the process 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. Finally, 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 and drying method. Too little or too much wetting agent can lead to uneven drying. Remove excess rinse solution from the film before drying.

REUSING DEVELOPER WITHOUT REPLENISHMENT

Working strength solutions of ILFOSOL S 1+9 and 1+14 and ILFOTEC LC29 1+29 are described as a one-shot developers. They should be used only once and discarded, we do not recommend reusing them to process more than one film.

For the highest image quality ILFOTEC DD-X 1+4 and ILFOTEC LC29 1+9 and 1+19 should also be used as one-shot developers. However for greater economy they can be reused 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 ILFOTEC DD-X 1+4 and ILFOTEC LC29 1+9 and 1+19 can process provided that the developer is reused.

1 litre	films/litre
ILFOTEC DD-X 1+4	10
ILFOTEC LC29 1+9	10
ILFOTEC LC29 1+19	5

As each film or batch of films is processed it releases halides and other by-products 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.

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If a series of individual films is being developed in a spiral tank using either 1 litre of ILFOTEC DD-X 1+4 or ILFOTEC LC29 1+9 and 1+19, 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 135/36 film), being poured back into the working strength solution's storage 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 by-products.

1l working strength	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
ILFOTEC DD-X 1+4	1	2	3	4	5	10
ILFOTEC LC29 1+9	1	2	3	4	5	10
ILFOTEC LC29 1+19	1	2	3	4	5	nr

N = standard development time
nr = not recommended

When larger quantities of developer are in use increase the number of films that can be processed proportionally with the volume of working strength developer being used, e.g. if 5 litres of stock ILFOTEC DD-X 1+4 are being used then increase the development times by 10% after processing every batch of 5 films. The following table shows for each developer the total amount of working strength solution that can be prepared from one bottle of concentrate along with the number of films that can be processed before each 10% increase in development time.

ILFOTEC DD-X 1+4

working strength solution (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

N = standard development time

ILFOTEC LC29 1+9

working strength solution (litres)	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
2.5	1-3	4-5	6-7	8-10	11-12	23-25

ILFOTEC LC29 1+19

working strength solution (litres)	N	N+ 10%	N+ 20%	N+ 30%	N+ 40%	N+ 90%
5	1-5	6-10	11-15	16-20	21-25	nr

nr = not recommended

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. The time compensation 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 your negatives are night shots which will be 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 because they are of beach scenes in bright sunlight then more 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 using ILFOTEC DD-X 1+4 or ILFOTEC LC29 1+9, 1+19 and 1+29 or ILFOSOL S 1+9 and 1+14 eliminates or greatly reduces these problems. One-shot processing is recommended when image quality, reliability and consistency are more important than economy.

We do not recommend push processing using reused developers.

WORKING SOLUTION LIFE

ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S working strength solutions should not be kept for more than 24 hours. Make up fresh developer each time it is needed and discard it after the processing session.

STORAGE

Always store chemicals in their original containers and away from unsupervised children and pets. In cool, dry conditions, 4–20°C (44–68°F) ILFOTEC DD-X, ILFOTEC LC29 and ILFOSOL S developer concentrates should keep in good condition for the following time periods.

ILFOTEC DD-X

24 months in full tightly capped bottles.
6 months in half full tightly capped bottles.

ILFOTEC LC29

36 months in full tightly capped bottles.
6 months in half full tightly capped bottles.

ILFOSOL S

24 months in full tightly capped bottles.
4 months in half full tightly capped bottles.

AVAILABILITY AND CAPACITY

ILFOTEC DD-X is available in 1 litre bottles world-wide. Used at 1+4 for one shot processing it will develop 16 135/36 films. If reuse techniques are used it will develop up to 50 135/36 or 120 films.

ILFOTEC LC29 is available in 250ml bottles in all markets except those served via North America. The following table gives the developing capacity of a 250ml bottle of ILFOTEC LC29.

	one-shot	reuse
at 1+9	8	25
at 1+19	16	25
at 1+29	25	nr

ILFOSOL S is available in North America in 500ml bottles and the rest of the world in 250ml bottles. 250ml at 1+9 will process 8 135/36 films. 250mls at 1+14 will process 12 135/36 films.

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.