FUJIFILM
Value from Innovation

TECHNICAL BULLETIN

PROCESS PRO6

CHEMICAL SYSTEM

For the processing of films compatible
with the E6 process

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Technical docs available on FUJIFILM websites :

- FUJIFILM Europe\Photochemicals : PL Product lists & TB technical bulletins
- FUJIFILM Belgium ESCLUSIVO : distributor web site for PL Product lists & TB technical bulletins, PIS Product Information Sheets, TIS Technical Information Sheets, SG Sales Guides, OASIS process control, …
- originalphotopaper.com/products/photochemicals/

Your local FUJIFILM representative can give technical advice if required.

I. INTRODUCTION

This new issue of the Technical Bulletin "**FUJIFILM Pro6 Chemical System**" contains all information on FUJIFILM's E6 products.

Today's trend in the market indicates considerably lower processing volumes of E6 films. As a result, low throughput conditions are occurring more frequently and increase the risk of process instability. FUJIFILM has studied in-depth this market situation and generated important field-data, allowing us to support you with unique Professional advice. Your local FUJIFILM technical representative will be pleased to discuss all details with you.

This Technical Bulletin has been well accepted by the market. It not only tells you a bit more about the individual process steps and functions, but just as importantly, it will guide you in more detail through the specific characteristics of each product individually, making it easier for the customer to make the correct choice. Other important information in this bulletin is the very latest table on "Push & Pull" times followed by the mixing instructions and, very importantly, pH and density specifications. Process Monitoring, Chemical Handling and Storage complete this Technical Bulletin.

Even though this Technical Bulletin contains a lot of important information, we also realize that additional information may be wanted in your day-to-day operation.

If you have any queries, FUJIFILM has a large and experienced team of Technical Experts available to you.

Do not hesitate to contact your local FUJIFILM representative; he will be most happy to assist you at any time.

II. PROCESS DESCRIPTION

Pro6 Chemicals have been designed to process all brands of films compatible with E6 process. These chemicals are all liquid and can be used in a variety of automatic processing machines and in manual processing operations.

III. PROCESSING STEPS

1. PROCESSING STEPS FUNCTIONS & ADDITIVES

The E6 process consists of seven chemical baths. A brief description of the purpose of each bath follows:

A. First Developer

The first developer produces three black and white negatives corresponding to the three separate emulsion layers sensitive to blue, green and red light. The first developer performs the most important function in the E6 process and for this reason must be accurately controlled. The developer is a low activity bath, highly buffered to resist major fluctuations in pH. It is designed to maintain pH balance with a fixed rate of replenishment and when first developer activity is altered it should be accomplished by adjustments to time and/or temperature only. Although replenishment rates should not be altered, deviation in rates by 5% to 10% has relatively little effect on photographic quality.

FUJIFILM offers the **Pro6 First Developer Replenisher**.

To make a fresh first developer tank solution, starting from **Pro6 First Developer Replenisher**, **Pro6 First Developer Starter** is used.

B. First Wash

The first wash stops the development action of the first developer and washes the first developer from the film emulsion to prevent contamination of the reversal bath. Flow rates of 4 litre to 10 litre per minute are necessary at temperatures between 33°C and 39°C.

C. Reversal 2 Bath

Reversal bath "fogs" the undeveloped silver halide grains that were not converted to metallic silver in the first developer. The reversal bath is acidic, yet it must be carried into the colour developer without squeegeeing or a wash step. This is important because full nucleation (fogging) is achieved only when the reversal agent becomes alkaline in the colour developer bath.

Reversal bath should be circulated sufficiently to ensure adequate mixing of replenisher additions. The solution is easily oxidised and should not be agitated with air.

FUJIFILM offers the **Pro6 Reversal 2 Bath & Replenisher**.

D. Colour Developer

The colour developer develops the silver halide fogged in the reversal bath and produces the coloured image. Because of carry-over of the acid reversal bath, the pH of colour developer has a tendency to drop. To maintain the correct pH it is important to use recommended replenishment rates. Sometimes the pH may need to be adjusted by means other than replenishment rates. To do so, either sodium hydroxide or sulphuric acid are used. Deviations from the recommended developer pH will affect the colour balance of processed film depending on the brand type.

FUJIFILM offers the **Pro6 Colour Developer Replenisher**.

To make a fresh colour developer tank solution, starting from **Pro6 Colour Developer Replenisher**, **Pro6 Universal Colour Developer Starter** is used.

E. Pre-Bleach 2

The pre-bleach prepares the developed metallic silver for bleaching and simultaneously promotes dye stability of the final image.

The pre-bleach aids in preserving the acidity of the bleach and minimises the effects of colour developer carry-over. The conditioning agent oxidises very readily and should not be agitated by air. It should be circulated sufficiently to ensure effective mixing of replenisher additions.
Carry-over of sufficient pre-bleach is necessary to guarantee adequate bleaching.
Carefully control the density as an excess dilution of pre-bleach can cause dye stability problems.

FUJIFILM offers the **Pro6 Pre-Bleach 2 & Replenisher**.

Pro6 Pre-Bleach 2 must be used in combination with **Pro6 Final Rinse** as this final bath no longer contains the “dye stabilizing enhancer”.

Pro6 Pre-Bleach 2 should not be kept more than one week as a replenisher without a floating lid as small amounts of precipitate may form. Particularly in low throughput situations, the **Pro6 Pre-Bleach 2** working tank should also be changed on a regular basis – at least monthly.

F. Bleach

Pro6 Bleach is a ferric ammonium EDTA bleach to oxidise all the metallic silver formed in first and colour development into silver salts, which are then removed from the film by the fixer bath which follows.

It is necessary to bubble air into the bleach tank to maintain its effectiveness.

Since developer carry-over can reduce the activity or increase the pH of the bleach, it is advisable to increase the replenishment rate of the conditioner or the pre-bleach, not that of the bleach, if there is a problem of high pH.

FUJIFILM offers the **Pro6 Bleach Replenisher**.

To make a fresh first bleach tank solution, starting from **Pro6 Bleach Replenisher**, **Pro6 Bleach Starter** is used.

Optional: **Pro6 Bleach Regeneration**

> Pro6 Bleach regeneration is easily carried out and offers significant cost reduction, and also reduces quantities of bleach overflow into the drain.
> Pro6 Bleach regeneration is not recommended in a Professional lab environment.
>
> Please consult your local FUJIFILM technical representative for more information.

G. Fixer

The fixer removes silver salts from the film emulsion. Since there is no wash between the bleach and fixer, iron from the bleach is carried into the fixer. It is therefore necessary to bubble air through the fixer tank to oxidise the iron, to prevent the formation of leuco cyan dye in processed film. Care must be taken to not over aerate, as too much air can destroy the fixer by oxidation. It is recommended that aeration is only carried out when film is being processed.

Some laboratories prefer to install a wash between the bleach and fix in order to reduce bleach carry-over into the fix. This means that the fixer can then be mixed with other fixers used in negative and paper processes for closed circuit operation.

FUJIFILM offers the **Super Unilec Fixer**.

Super Unilec Fixer can be used in a simple replenished system, as a non-desilvered replenished fixer and in a closed loop continuous electrolytic desilvering system at a reduced replenishment rate.

H. Second Wash (Final)

The final wash removes residual fixer and silver halide complexes from the film. Should processing by-products remain in the film after drying, it is possible that colour changes or dye fading will occur.

I. Final Rinse

The final rinse guarantees spot-free, uniform film drying and minimizes backside scumming.
FUJIFILM offers the **Pro6 Final Rinse & Replenisher**.

Pro6 Final Rinse must be used in combination with **Pro6 Pre-Bleach 2** as this final bath no longer contains the “dye stabilizing enhancer”.

It is recommended that this bath be changed on a regular basis.

J. Additives

Additive to avoid biological growth in wash tank

It is unusual for biological growth to be found in well-maintained processors with open wash systems and adequate wash water flow rates. If problems are experienced, your first step should be an examination the water supply system and quality, carried out by a specialist company.
A biocide (Acticide MV) compatible with photographic processors is available.

Please discuss with your representative.

2. PROCESSING STEPS CONFIGURATIONS

A. First Developer

First Developer Replenisher

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
6 min	38.0 ± 0.3°C	2150 mL/m²	Y	Y	Y

Agitation

Rack & Tank machines. Use one 2-second burst of nitrogen every 6 to 10 seconds only while film is being processed. Use sufficient pressure to raise surface level 1.5 cm.

It is important that oil free humidified nitrogen is used.

In Continuous machines. Supply nitrogen at 38 litre per square meter of film or 0.23 m³ per hour, whichever is more. Reduced agitation can cause film streaking and lowered developer activity.

Recirculation

50% or more of the total tank volume should be recirculated every minute

Filter requirements

It is recommended that 25-micron filters made of polyethylene or polypropylene are used. Filters made of wool, nylon or cotton are not recommended, as they adversely affect the photographic properties of the processing solutions.

B. First Wash

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
2 min	33 to 39°C	40 L/m²	Y	N	N

Agitation

Rack & Tank machines. Air may be used at the rate of one 2-second burst every 10 seconds. It is important that the air used is oil free.

Filtration

Use a 25-micron filter to filter incoming water. In areas of very poor water quality it may be necessary to use a 10-micron filter.

C. Reversal 2 Bath

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
2 min	24 to 39°C	1075 mL/m²	N	Y	Optional

Agitation

None is required for this bath.

Recirculation

Recirculation should be just sufficient to ensure that the concentration of reversal bath is uniform. A non-uniform concentration can cause uneven colour balance on a processed film.

Note: Solution life is increased by using a lower processing temperature.

D. Colour Developer

Colour Developer Replenisher / Colour Developer Regenerator

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
6 min	38.0 ± 0.6°C	2150 mL/m²	Y	Y	Y

Agitation, filtration and recirculation requirements are the same as for First Developer.

E. Pre-Bleach 2

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
2 min.	24 to 39°C	1075 mL/m²	N	Y	Optional

Agitation, filtration and recirculation requirements are the same as for Reversal Bath.

F. Bleach

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
6 min	33 to 39°C	215 mL/m²	Y	Y	Y

Note: These values are for a 6 minutes bleaching time. For 4 minutes bleaching time the replenishment rate should be doubled.

Agitation

Rack & Tank machines. Air must be at the rate of one 2-second burst every 8 to 10 seconds.
It is important that the air used is oil free.

Continuous machines. Air must be supplied at the rate of 51 litre per square meter of film or 0.23 m³ per hour, whichever is more.

Recirculation

20% or more of the total tank volume should be recirculated every minute.

Filter requirements

It is recommended that 25-micron filters made of polyethylene or polypropylene are used. Filters made of wool, nylon or cotton are not recommended, as they adversely affect the photographic properties of the processing solutions.

G. Fixer

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
4-6 min	33 to 39°C	1075 mL/m²	Y	Y	Y

Note: This applies to 4 to 6 minutes fixing times. For 2 to 3 minutes fixing times increase replenishment rate by 25%. The concentration also may need increasing to ensure all film types are fully fixed. It may also be necessary to increase the fix concentration if there is a wash between the bleach and fix, as carryover from the wash will dilute the fix bath. When using **Super Unilec Fixer** in a closed loop continuous electrolytic desilvering system a reduced replenishment rate can be used.

Agitation, filtration and recirculation requirements are the same as for Bleach.

H. Final Wash

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
4-6 min	33 to 39°C	40 to 80 L/m²	Y	N	Y

Note: If the final wash water flow can be maintained at the recommended rate, one 4-minute wash may be used. However, it is preferable to operate two 2-minutes counterflow washes.
For some current film emulsions it is important to maintain the correct wash rate at a temperature of about 38°C.

Agitation, filtration and recirculation requirements are the same as for First Wash.

I. Final Rinse

Time	Temperature	Replenishment Rate	Agitation	Recirculation	Filtration
1 min	Ambient	1075 mL/m²	N	N	N

J. Drying

Temperature	Relative Humidity
< 63°C	50% to 70%

Filtration: Incoming air into drier should be filtered to remove airborne particles.

3. STANDARD REPLENISHMENT AND WATER FLOW RATES

Continuous Type Processor – Replenishment Rates and Flow Rates		
	mL/m²	**mL/m of 135 film**
First Developer	2150	72
First Wash	40 L/m²	1.2 L/m
Reversal 2 Bath Replenisher	1075	36
Colour Developer Replenisher	2150	71
Pre-Bleach 2 Replenisher	1075	36
Bleach Replenisher (1)	215	7
Fixer Replenisher (2)	1075	36
Second Wash	Counter-current cascade water flow from 3rd Wash. (3)	
Third Wash	40 - 80 L/m²	1.2 - 2.4 L/m
Final Rinse Replenisher	1075	36

(1) The bleach replenishment rates shown in the table apply to 6-minute bleaching (standard processing specification). When 4 minute bleaching is to be used, double the bleach replenishment rates shown in the table.

(2) The fixer replenishment rates shown in the table apply for 4-minute fixing (standard processing specification). Increased fix concentration may improve results from certain film emulsions. When using **Super Unilec Fixer** in a closed loop continuous electrolytic desilvering system a reduced replenishment rate can be used.

(3) If the wash water flow is not cascaded from 3rd wash to 2nd wash, use the 3rd wash flow rates shown in the table for both 2nd wash and 3rd wash tanks.

Dip and Dunk Type Processor Replenishment Rates and Water Flow Rates (mL/roll or sheet)				
	135-24	**135-36**	**120** (1)	**4 x 5" (10.2 x 12.7 cm)**
First Wash	1.5 L	2.0 L	1.9 L	0.5 L
Reversal 2 Bath Replenisher	40	56	55	13.5
Pre-Bleach 2 Replenisher	40	56	55	13.5
Bleach Replenisher (2)	8	11.1	11	2.8
Fixer Replenisher (3)	40	56	55	13.5
Second Wash	Counter-current cascade water flow from 3rd Wash. (4)			
Third Wash	1.5 - 3.0 L	2.0 - 4.0 L	1.9 - 3.8 L	0.5 - 1.0 L
Final Rinse Replenisher	40	56	55	13.5

(1) Replenishment rates and water flow rates are doubled for 220 size film.

(2) The bleach replenishment rates shown in the table apply to 6-minute bleaching (standard processing specification). When 4-minute bleaching is to be used, double the Bleach replenishment rates shown in the table.

(3) The fixer replenishment rates shown in the table apply for 4-minute fixing (standard processing specification). Increased fix concentration may improve results from certain film emulsions.
If 2 to 3 minute fixing is to be used, increase the Fixer replenishment rates in the table by 25%. Some film emulsions may also need increased fixer concentration. When using **Super Unilec Fixer** in a closed loop continuous electrolytic desilvering system a reduced replenishment rate can be used.

(4) If the wash water flow is not cascaded from the 3rd wash to 2nd wash, use the 3rd wash flow rates shown in the table for both 2nd wash and 3rd wash tanks.

4. FILM AREAS

Film Size	Film Area
135-24 **(1)**	0.0374 m² **(1)**
135-36 **(1)**	0.0514 m² **(1)**
120	0.0504 m²
220	0.1020 m²
4 x 5"	0.0129 m²
10" x 8"	0.0516 m²
14" X 11"	0.0993 m²

(1) The leader portions are not taken into account

IV. PROCESS E6 PUSH & PULL

This process is used for Fujichrome professional films and Kodak Ektachrome professional films that have been either under- or over-exposed. By varying the First Developer processing times the optimum results can be obtained from the file. Compensating for this under- or overexposure may result in a change of contrast, Dmax and grain.

1. FUJI FILMS

Professional films(*)	- ½	- 1/3	N	+ 1/3	+ 1/2	+ 2/3	+ 1	+ 1 1/3	+ 1 1/2	+ 1 2/3	+ 2	+ 2 1/3	+ 2 1/2
64T (RTP II)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	13'00"	14'00"
	40 ISO	50 ISO	**64 ISO**	80 ISO	90 ISO	100 ISO	125 ISO	160 ISO	180 ISO	200 ISO	250 ISO	320 ISO	360 ISO
Velvia 50 (RVP)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	13'00"	14'00"
	32 ISO	40 ISO	**50 ISO**	64 ISO	70 ISO	80 ISO	100 ISO	125 ISO	140 ISO	160 ISO	200 ISO	250 ISO	280 ISO
Velvia 100F (RVP 100F)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	13'00"	14'00"
	32 ISO	40 ISO	**50 ISO**	64 ISO	70 ISO	80 ISO	100 ISO	125 ISO	140 ISO	160 ISO	200 ISO	250 ISO	280 ISO
Astia 100F (RAP 100F)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	13'00"	14'00"
	64 ISO	80 ISO	**100 ISO**	125 ISO	150 ISO	160 ISO	200 ISO	250 ISO	280 ISO	320 ISO	400 ISO	500 ISO	560 ISO
Provia 100F (RDP III)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	13'00"	14'00"
	64 ISO	80 ISO	**100 ISO**	125 ISO	150 ISO	160 ISO	200 ISO	250 ISO	280 ISO	320 ISO	400 ISO	500 ISO	560 ISO
Provia 400F (RHP III)	5'00"	5'30"	**6'00"**	6'30"	7'00"	7'30"	8'00"	9'00"	9'30"	10'00"	11'00"	12'00"	12'30"
	250 ISO	320 ISO	**400 ISO**	500 ISO	560 ISO	640 ISO	800 ISO	1000 ISO	1120 ISO	1250 ISO	1600 ISO	2000 ISO	2240 ISO

* For push and pull-processing of amateur films, please consult your local FUJIFILM representative.

Not recommended :	

When push-processing small amounts of film in a processor with large tanks, you may not need to increase the replenishment rate. Otherwise the First Developer replenishment rate should be adjusted as indicated in the table below. Any First Developer replenishment increase must be proportional to the amount of film push processed.

Push	FD rep rate
0	Standard
+1/3	+8%
+ 1/2	+12%
+1	+25%
+2	+50%
+3	+75%

V. MIXING INSTRUCTIONS

1. FIRST DEVELOPER

Pro6 First Developer Replenisher				
To make 1 litre	**Water**	**Conc.**	**Replenisher**	**Pro6 First Developer Starter**
REPLENISHER	800 mL	200 mL	-	-
TANK	795 mL	200 mL	-	5 mL
Tank from Repl	-	-	995 mL	5 mL

2. REVERSAL BATH

Pro6 Reversal 2 Bath & Replenisher(1)			
To make 1 litre	**Water**	**Conc.**	**Replenisher**
REPLENISHER	950 mL	50 mL	-
TANK	965 mL	35 mL	-
Tank from Repl	300 mL	-	700 mL

(1) Correction for Colour balance at fresh tank Pro6 Reversal 2
A pH increase of a fresh tank Pro6 Reversal 2 will offer a slightly higher blue on Fuji Control Strips.
1 mL/L addition (NaOH 5N) – pH @ 25°C 5.50 ± 0.05
2 mL/L addition (NaOH 5N) – pH @ 25°C 5.75 ± 0.05

3. COLOUR DEVELOPER

Pro6 Colour Developer Replenisher					
To make 1 litre	**Water**	**Part A**	**Part B**	**Replenisher**	**Pro6 Universal Colour Dev. Starter**
REPLENISHER	600 mL	200 mL	200 mL	-	-
TANK (1)	657 mL	170 mL	170 mL	-	3 mL
Tank from Repl	147 mL	-	-	850 mL	3 mL

(1) Preparing new Colour Developer tank solutions.
The recommended **Pro6 Universal Colour Developer Starter** additions above are satisfactory in most laboratories. However, in some processors they may be found to give a slightly low green (with FUJIFILM CR56/E6) on preparing a fresh working tank solution. Note that for Pro6 Colour Developer the previous recommendations were to use 5 mL/litre of Starter when preparing a new working tank; this may cause problems with the latest film emulsions.
Additionally, adding an additional 5% of water to a new Colour Developer tank solution will give a slight increase in DMax compared to the recommended additions above, and is recommended in laboratories carrying out significant amounts of push processing. This additional water can be added during preparation of the new tank solution, but is better added (if required) after evaluation of a process control strip where the HD and DMax are found to be low.

Note that the above recommendations ONLY apply to preparation of fresh Colour Developer working tank solution; these changes do not affect preparation of replenisher or the replenishment rates.

4. PRE-BLEACH 2

Pro6 Pre-Bleach 2 & Replenisher		
To make 1 litre	**Water**	**Conc.**
TANK & REPLENISHER	900 mL	100 mL

5. BLEACH

Pro6 Bleach Replenisher			
To make 1 litre	**Water**	**Conc.**	**Pro6 Bleach Starter**
REPLENISHER	-	1000 mL	-
TANK	480 mL	500 mL	20 mL

6. FIXERS

Super Unilec Fixer		
To make 1 litre	**Water**	**Conc.**
TANK & REPLENISHER	900 mL	100 mL

7. FINAL RINSE

Pro6 Final Rinse & Replenisher		
To make 1 litre	**Water**	**Conc.**
TANK & REPLENISHER	990 mL	10 mL

VI. pH AND DENSITY SPECIFICATIONS

1. FRESH TANK SOLUTION

pH AND DENSITY SPECIFICATIONS FOR FRESHLY PREPARED TANK SOLUTIONS				
Product	**Tank**			
	pH	**Density (g/cm³)**		
	(25°C)	**(20°C)**	**(25°C)**	**(38°C)**
First Developer	9.60 ± 0.05	1.062 ± 0.003	1.061 ± 0.003	1.057 ± 0.003
Reversal 2 Bath	5.25 ± 0.05	1.004 ± 0.001	1.003 ± 0.001	1.001 ± 0.001
Colour Developer	11.95 ± 0.05	1.034 ± 0.003	1.035 ± 0.003	1.031 ± 0.003
Pre-Bleach 2	6.20 ± 0.10	1.019 ± 0.003	1.018 ± 0.003	1.015 ± 0.003
Bleach	5.65 ± 0.10	1.134 ± 0.005	1.133 ± 0.005	1.128 ± 0.005
Super Unilec Fixer	7.50 ± 0.20	1.044 ± 0.010	1.043 ± 0.010	1.040 ± 0.010
Final Rinse	-	~ 0.999	~ 0.999	-

2. REPLENISHER

pH AND DENSITY SPECIFICATIONS FOR FRESHLY PREPARED REPLENISHER			
Product	**Tank**		
	pH	**Density g/cm³**	
	(25°C)	**(20°C)**	**(25°C)**
First Developer Replenisher	9.70 ± 0.05	1.062 ± 0.003	1.061 ± 0.003
Reversal 2 Bath	5.25 ± 0.05	1.006 ± 0.001	1.005 ± 0.001
Colour Developer Replenisher	12.25 ± 0.05	1.040 ± 0.003	1.039 ± 0.003
Pre-Bleach 2	6.20 ± 0.10	1.019 ± 0.003	1.018 ± 0.003
Bleach	5.45 ± 0.10	1.259 ± 0.005	1.257 ± 0.005
Super Unilec Fixer	7.50 ± 0.20	1.044 ± 0.010	1.043 ± 0.010
Final Rinse	-	~ 0.999	~ 0.999

3. SEASONED TANK SOLUTION

pH AND DENSITY SPECIFICATIONS FOR SEASONED TANK SOLUTION				
Product	**Tank**			
	pH	**Density g/cm³**		
	(25°C)	**(20°C)**	**(25°C)**	**(38°C)**
First Developer	9.70 ± 0.05	1.065 ± 0.003	1.064 ± 0.003	1.060 ± 0.003
Reversal 2 Bath	5.75 ± 0.10	1.006 ± 0.002	1.005 ± 0.003	1.002 ± 0.003
Colour Developer	11.95 ± 0.05	1.038 ± 0.003	1.036 ± 0.003	1.032 ± 0.003
Pre-Bleach 2	6.70 ± 0.30	1.022 ± 0.003	1.021 ± 0.003	1.018 ± 0.003
Bleach	5.80 ± 0.25	1.185 ± 0.045	1.184 ± 0.045	1.179 ± 0.045
Super Unilec Fixer	6.70 ± 0.50	1.065 ± 0.010	1.064 ± 0.010	1.060 ± 0.010
Super Unilec Fixer (processors with wash after bleach tank)	6.70 ± 0.50	1.044 ± 0.010	1.043 ± 0.010	1.040 ± 0.010
Final Rinse	-	-	-	-

The above specifications are suitable for most E6 processors and film emulsions. However, occasionally it may be found that some film types on processing conditions require slightly different specifications. If in doubt please consult your local FUJIFILM technician.

VII. PROCESSING DURING LOW-UTILISATION PERIODS

During low-utilisation periods when daily throughput remains at levels less than 10% of tank volume*, it becomes difficult to maintain the processing solutions within specification. During these low-utilisation periods, it is necessary to take compensatory actions, such as tank solution and replenisher modification and replenishment rate changes. When the daily throughput has recovered to beyond 10% of tank volume*, processing conditions should be restored to normal.

A great help in low throughput laboratories, with the continuing general decrease in processed E6 film volumes, is simply to keep the processor running for fewer hours. Many laboratories have achieved considerable improvements in quality – and ease of maintaining that quality – by taking steps such as running (i.e. with recirculation switched on and solutions heated) for fewer hours per day, or even by running for (for example) three days per week instead of five. Where your circumstances permit, you should give serious consideration to such steps – leaving the machine COMPLETELY switched off for extended periods will do much to maintain chemical activity and process quality. Do not forget to replace the floating lids (on hanger machines) at all times when the processor is not in use.

* Tank volume: When the volume of replenisher which is consumed by film a processor becomes equal to the volume of the processing tank, such is defined as one tank volume throughput. Accordingly, a "daily 10% tank volume throughput" means the amount of replenisher consumption is one-tenth the tank solution volume per day. For instance, when a tank having a volume of 75 litres of solution is replenished by 7.5 litres of replenisher by day, the daily throughput is 10% of tank volume.

1. FIRST DEVELOPER

Aerial oxidation causes a considerable decrease in the developing agent and preservative. In addition, evaporation causes the developer solution to become over-concentrated. As a result, speed reduction and overall gradation changes occur in the film.

Compensatory action

Add water to the first developer tank solution to maintain the density within control limits and increase the replenishment rate by 5% to 10%.
If this compensation is not sufficient the replenishment rate should be further increased; however, a simple increase in replenishment rate alone will cause a loss of developer component balance. In this case a modified replenisher should be prepared and used. This modified replenisher must contain a volume of starter equal to the percentage increase in the replenishment rate.
Modified replenisher preparation specifications are indicated in the following table.
The replenishment rate should be successively increased until the process is brought back to within the action limits.

Modified Replenisher preparation specifications in relation to Replenishment Rate increase

Rate of Starter Addition /increase in Replenishment Rate	Amount of Starter Added to 1 litre of Replenisher	Amount of Starter Added to 50 litres of Replenisher	Proportion of Starter
15%	0.75 mL	37.5 mL	15%
20%	1.00 mL	50.0 mL	20%
25%	1.25 mL	62.5 mL	25%
30%	1.50 mL	75.0 mL	30%
35%	1.75 mL	87.5 mL	35%
40%	2.00 mL	100.0 mL	40%
45%	2.25 mL	112.5 mL	45%
50%	2.50 mL	125.0 mL	50%
55%	2.75 mL	137.5 mL	55%
60%	3.00 mL	150.0 mL	60%

Developer replenishers are designed to compensate tank solutions for chemical components consumed and produced not only by the development reactions but also by aerial oxidation.

For both the **First Developer** and the **Colour Developer**, 2150 mL of replenisher per square metre of processed film are needed to compensate for the development reactions and the small amounts of aerial oxidation which occur at processing throughput rates of more than 10% of tank volume.

At processing throughput levels less than 10% of tank volume, tank solution aerial oxidation becomes greater and greater. In such cases, the process still requires this same amount of replenisher per square metre of processed film as with normal throughput levels. The tank working solutions also require additional amounts of fresh tank solution to replace the considerable amounts of aerially oxidised tank solution.

When processing throughput levels drop below 10% of tank volume, it is thus essential that a modified replenisher be used; this being composed of a combination of normal replenisher and fresh tank solution. This modified replenisher should then be supplied at incrementally increasing rates that are determined in relation to the volume of fresh tank solution contained in the modified replenisher. Such procedures will not only provide proper replenisher volumes in relation to the amounts of film processed but will also provide for enough tank solution replacement to renew the processing solutions and maintain proper developer performance.

2. REVERSAL 2 BATH

Aerial oxidation causes a decrease in the activity of the reversal bath. This will cause a decrease in D-max density with results drifting toward a yellow-red (Fujichrome) or green (Ektachrome) colour balance. To overcome or reduce this effect, mix the reversal replenisher using 40 mL/L reversal concentrate (instead of 50 mL) and double the replenishment rate. This procedure has several benefits including:

a) Increased tank turn-over rate due to increased replenishment rate.
b) The effect of aerial oxidation is reduced.
c) Reduced acid carry-over to colour developer, therefore increasing pH stability of the developer.
d) Dilution effect from first wash carry-in reduced due to higher replenishment rate.

Modified Mixing Instructions for Pro6 Reversal 2 Bath Replenisher(1)

Pro6 Reversal 2 Bath conc.		
To make 1 litre	**Water**	**Conc.**
REPLENISHER	960 mL	40 mL

(1) Replenishment rate is double the recommended rate, i.e. from 1075 mL/m² to 2150 mL/m².

3. COLOUR DEVELOPER

Aerial oxidation causes a decrease in the colour developing agent, competitive coupler and preservative. In addition, evaporation causes solution concentration, and carbon dioxide in the air is absorbed resulting in a lowering of solution pH. This will cause an increase in D-max density with results drifting toward a magenta-red (Fujichrome) or blue (Ektachrome) colour balance.

Compensatory action

Add water to the colour developer tank solution to maintain its density within control limits and increase the replenishment rate by 5 to 10%. If this compensation is not adequate the replenishment rate should be further increased; a simple increase in replenishment rate only will cause a loss of developer component balance consequently as with the first developer a modified replenisher should be prepared and used. This modified replenisher must contain a volume of starter equal to the percentage increase in the replenishment rate.

Modified replenisher preparation specifications are indicated in the table on page 18. The replenishment rate should be successively increased until the process is brought back to within the action limits.

To control the pH decline, add diluted Sodium Hydroxide (e.g. NaOH 5 molar).

VIII. HANDLING PROCESSING SOLUTION

1. STORAGE OF SOLUTIONS

	With floating lids		Without floating lids
	Fresh Solutions	Partially Used Solutions	All Solutions
First Developer Tank	6 weeks	3 weeks	1 week
First Developer Replenisher	6 weeks	-	1 week
Reversal Bath Tank	6 weeks	3 weeks	1 week
Reversal 2 Bath Replenisher	6 weeks	-	1 week
Colour Developer Tank	6 weeks	3 weeks	2 weeks
Colour Developer Replenisher	6 weeks	-	2 weeks
Pre-Bleach 2 Tank	6 weeks	3 weeks	1 week
Pre-Bleach 2 Replenisher	6 weeks	-	1 week
Other Solutions	24 weeks	12 - 16 weeks	8 - 12 weeks

2. CHEMICAL WARNING

All photographic processing solutions can exert harmful effects when brought into contact with human tissue to a greater or lesser extent depending on the nature of the solution and its concentration. All users of such solutions should exercise the greatest care to avoid the chemicals contacting the skin, eyes or other parts of the body.

Always wear solution resistant gloves and effective eye protection. In case of accidental contact with processing solutions wash the affected part with plenty of clean cold running water. Consult a medical doctor.

Some photographic solutions produce irritating vapours therefore thorough ventilation is essential.
Do not inhale air above processing solutions.

Always read the hazard information on the packs of solution concentrate before attempting to handle the solutions.

IX. CARE AND STORAGE OF SOLUTIONS

All FUJIFILM Belgium chemicals for use with the E6 process are supplied as all-liquid concentrates. They dissolve readily in water and no excessive mixing time is required. A maximum of 30 seconds mixing is needed to ensure complete dissolution after the addition of each concentrate to the solution being prepared.

None of the chemicals when used under normal conditions is subject to undue oxidation. However, the volume of developer replenisher prepared should not be for more than one week's normal consumption. Longer storage times will increase the degree of oxidation and lead to lower process activity.

The use of floating lids where replenishers are stored in vats will assist in reducing oxidation, especially in processors subject to low film throughput.

NEVER mix or store developer in containers that have contained bleach, fixer or bleach-fix, due to the risk of severe developer contamination. It is good practice to check the calibration of mixing vats once per year to ensure that changes in the shape of the vat have not occurred, thus giving rise to incorrect volumes.

X. PROCESS MONITORING

It is recommended that the activity level of the chemical baths in each film processor should be monitored daily. Pre-exposed **FUJI CR-56/E6** control strips should be run at least 2 or 3 times each day; the first strip prior to processing film, and then at evenly spaced intervals during production.

Whenever corrective action is taken, either to improve process control or adjust the processing machine, a control strip should be run to determine the effects of the change. It is wise to adjust the processor only after a trend has been established, which usually requires at least three control strips to have been run.

It is strongly urged that each photo-processing laboratory keep at least two code numbers of series of strips on hand as variation between different series can occur. Variations with a new code number may not be caused by the processor, but rather may be the difference between the control strips themselves. It should be standard practice to process two strips with the new and old codes together to check that both strips record the same chemical activity. It is also recommended that the densitometer be re-calibrated and that reference strips be re-read in case any large deviations are experienced. This procedure will eliminate erroneous readings due to a problem with the densitometer or strips.

FUJIFILM Belgium recommends the use of the **OASIS Pro** quality control system for local process monitoring and can also offer a highly professional monitoring service. Please consult your FUJIFILM representative or look for **OASIS Pro** on the FUJIFILM Europe Photo chemicals website.

XI. TROUBLESHOOTING FOR THE E6 PROCESS

Within the scope of this brochure, it is not possible to give a full description of all of the process variations that can occur with different manufacturers film types.

Most process control problems are traced to variations in temperature, too short an immersion time, too high or too low a replenishment rate or inadequate circulation – or, increasingly as film volumes decline – problems with evaporation and/or oxidation (especially for the developer). Occasionally, chemicals are mixed improperly and sometimes the bleach is not being aerated.

Problems indicated by out of control blue and green values, are usually traceable to the developer step. Low red values, on the other hand, are most often caused by under active bleach. Contrast is greatly affected by the agitation rate in the developer.

As a general rule, where you have a choice of actions for solving or investigating a process control problem and you have no specific indication that one particular course of action is the answer, choose a simple physical change as the first test - usually temperature. It is easy to change a temperature up or down, and little time is lost. You should only make chemical changes when you have checked the basic physical parameters - once you have put chemicals (or water) into a processor tank, you cannot take them out! Do not forget to process a further strip if you have made a change to the process.

XII. TROUBLESHOOTING CHART

Problem	Probable Cause(s)	Corrective Action(s)
Slow photographic speed. Speed step density values out of limits above reference line. Transparencies look too dark.	1. Temperature too low in first developer. 2. First or both developers under replenished. 3. Temperature too low in first developer. 4. First developer tank solution too dilute, low density. 5. Too much water added during mixing of first or colour developer replenisher. 6. Too much first developer starter added in making tank solution. 7. Little or no agitation in either the first or colour developers. 8. Colour developer tank solution too diluted, low density (s.g.). (in addition to slow speed, a colour shift to magenta will be evident, Fuji and Kodak film). 9. If large quantities of duplicating film are processed.	1. Adjust temperature; use lab thermometer. 2. Reset replenisher metering equipment and recalculate film loads. 3. Adjust to correct time. 4. Adjust to correct density using 5. Remix replenisher, check in-line automatic (A.R.) mixing unit (check concentrate/water ratio), check volume calibration of mixing vessels. 6. Dump and remix. 7. Check distributor bars for obstructions; flow of gas should be evenly dispersed. 8. It may be necessary in extreme cases to dump and remix colour developer. 9. Increase first developer replenishment rate by 10%.
Blue Colour Balance Kodak EP films, Magenta-Red Fuji and Kodak E100x films. Dmax and HD (colour step) blue density readings low; probably green HD high, red low Fuji and Kodak strips.	1. Colour developer pH too low. 2. Colour developer replenisher mixed improperly (insufficient Part A). 3. Too much colour developer starter used. 4. Insufficient nitrogen agitation colour developer or first and colour developers (Kodak only). 5. Reversal bath too concentrated.	1. Raise developer replenishment rate or add diluted NaOH (~ 10%) as required. 2. Dump and remix according to instructions. 3. Dump the bath and remix with correct amount of starter or try addition of diluted NaOH (~ 10%). 4. Check nitrogen supply and developer tank distributor bars for leaks or blockage. 5. Add proper amount of water. Check mixing procedure.

Problem	Probable Cause(s)	Corrective Action(s)
Fast photographic speed. Speed step density values out of limits below reference line. Transparencies look too light. .	1. Temperature too high in first developer. 2. First or both developers over replenished. 3. Time too long in first developer. 4. First and/or colour developer tank solution(s) too concentrated, high density. 5. Too little water added during mixing of first or colour developer replenisher. 6. Insufficient first developer starter used in making tank solution. 7. First developer contaminated by fixer. 8. Reduced water flow rate in wash after first developer. 9. Increase in temperature of first wash.	1. Adjust temperature; use lab thermometer. 2. Reset replenisher metering system and recalculate film loads. 3. Adjust to correct time. 4. Adjust to correct density using water. Is humidified nitrogen being used? 5. Check calibration of mixing equipment. 6. Adjust density with water 7. Add more starter according to mixing instructions. 8. Dump and remix; check for source of contamination. 9. Check and adjust water flow rate. Check and adjust temperature.
Yellow Colour Balance Kodak EP films, Slight Yellow Green Colour Balance FUJIFILM and Kodak E100 films. Dmax and HD (colour step) green density readings low, Fuji and Kodak strips.	1. Colour developer pH too high. 2. Insufficient colour developer starter used in preparation of tank solution. 3. First developer tank mix prepared with colour developer starter. Yellow balance Kodak film, yellow-red Fuji film with cyan high lights. 4. Insufficient Part B mixed when preparing colour developer replenisher. 5. If very yellow, film could be fogged or was exposed through base.	1. Add 10% Sulphuric acid as required. 2. Add prescribed amount of starter. 3. Dump first developer and remix. 4. Add prescribed amount of Part B. 5. Check for light leaks.
Green Colour Balance Kodak film, Yellow-Red FUJIFILM. Both film types have large decrease in D-max readings.	1. Reversal bath is under-active.	1a. Dump and remix. 1b. Mix less reversal bath (as replenisher); no more than can be used in one week. 1c. Make sure reversal bath is not oxidising. 1d. Make sure dust covers and floating lids are being used. 1e. See processing during low utilisation, page 1718.
Blue Colour Balance Kodak film, Cyan FUJIFILM.	1. First developer contaminated with fixer.	1. Dump first developer and remix. Trace source of contamination.

Problem	Probable Cause(s)	Corrective Action(s)
High D-Min (all colours). Highlights will appear darker with reduced contrast.	1. Bleach activity low. 2. Pre-Bleach activity low. 3. Fixer activity low. 4. First developer agitation reduced.	1. Check air flow into bleach tank. It may have been turned off or low. 2. Check replenishment rate of pre-bleach, it may be inadequate, especially with low throughput 3. Check replenishment rate and concentration of fixer are correct. Fixer oxidation / low throughput will also cause this problem. 4. Check nitrogen flow and look at distributor bar for blockage.
Random dark areas on film.	1. Bleach and/or fixer under-active.	1. Check replenishment, mixing procedure and solution agitation.
Film dark in appearance.	1. Temperature too low in first developer or the time is too short. 2. First developer under replenished. 3. Dark and Red appearance in sheet film indicates exposure through base.	1. Adjust time and temperature to specification. 2. Increase replenishment rate, check colour developer replenishment rate.
Film light in appearance.	1. Temperature too high in first developer or the time is too long. 2. First developer replenishment rate too high. 3. First developer contaminated by colour developer. 4. First developer over concentrated. 5. Film fogged before processing.	1. Adjust time and temperature to specification. 2. Adjust replenishment rates to specifications, check colour developer replenishment rate. 3. Dump contaminated first developer and remix. 4. Adjust tank with water, check mixing procedures.
Foaming in developer.	1. Excessive nitrogen use. 2. Nitrogen bubbles too small.	1. Reduce flow rate. 2. Increase outlet size of holes. 3. Use a defoamer applied around edge of tank above solution level, clean off daily.
High stain readings (all layers).	1. Temperature too low on either bleach or fix. 2. Time too short on bleach, fixer, conditioner or pre-bleach 3. Bleach under-aerated. 4. Fixer oxidised 5. Temperature too high or time too long in colour developer.	1. Adjust to specification. 2. Adjust to specification. 3. Check aeration system for flow and blockage in distributor bars. 4. Replace fixer (low throughput problem or excessive aeration) 5. Adjust colour developer time and temperature to specification.

Problem	Probable Cause(s)	Corrective Action(s)
Dirty film spots.	1. Final Rinse too concentrated. 2. Dirty film clips on rack and tank machines. 3. Chemical filters clogged allowing excessive dirt build-up. 4. Final Rinse not changed frequently enough. 5. Algae and fungi build-up in wash tanks. 6. Excessive defoamer will cause scum on the film.	1. Use recommended dilution. 2. Periodically wash film clips 3. Change filters more often. 4. Final Rinse should be dumped regularly (depending on film load). 5. Algae and fungi accumulations may be controlled by using Acticide MV. 6. Do not add defoamer to the solution; use only on the tank walls above solution level. Clean off daily.
Streaks - Density streaks - Coloured streaks	1. Usually caused by poor agitation of either first developer or first wash. 2. Weak reversal bath and/or poor colour developer agitation.	1. Check first developer and wash agitation. Check wash rate. 2. Dump and remix reversal bath. Check colour developer agitation. Make sure the first burst after the film enters the colour developer is soon enough.
Pink Highlights.	1. Pre-Bleach under-active. 2. Bleach either too dilute or concentrated. 3. Fixing time too short. 4. Fix temperature too low 5. Wash temperature too low. 6. Wash replenishment rate too	1. Change pre-bleach regularly. 2. Make sure bleach density is maintained within specifications. 3. If fix time cannot be increased, increase fix concentration and replenishment rate. 4. Increase fix temperature to 38°C 5. Increase wash temperature to 38°C 6. Increase wash rate to process specification. Check agitation.