

Industrial X-Ray System

CHEMICALS FOR AUTOMATIC FILM PROCESSORS

I. DESCRIPTION

FUJIFILM's Industrial X-Ray System consists of **Audel Developer Replenisher**, **Adstart Developer Starter** and **Aufix Fixer & Replenisher**.

Audel Developer has been carefully formulated to give good image sharpness, low grain, high gradation and superior maximum density with a wide variety of industrial X-Ray films. **Audel Developer** is very resistant against aerial oxidation and is extremely well protected against formation of processing sludge.

Aufix Fixer is a conventional fixer for straight replenishment. **Aufix Fixer** has a limited capacity for electrolytic desilvering.

II. MIXING INSTRUCTIONS

A. Audel Developer and Replenisher

1. **Audel Developer Replenisher**

To make 20L replenisher, add 5L part A to 14L of water and stir for one minute, add 0.5L part B and stir again for one minute, finally add 0.5L part C and stir again for one minute.

2. **Audel Developer**

To prepare developer tank solution, fill the processor $\frac{3}{4}$ full with **Audel Developer Replenisher**. Add 25 ml of **Adstart Developer Starter** for each litre of processor tank contents. Then top up to the overflow with **Audel Developer Replenisher**.

Table 1 Mixing instructions Developer and Replenisher

	Developer solution	Replenisher solution
Water	14 L	14 L
Audel Dev part A	5 L	5 L
Audel Dev part B	0.5 L	0.5 L
Audel Dev part C	0.5 L	0.5 L
Adstart	0.5 L	-
End volume	20,5 L	20 L

B. Aufix Fixer (Processor tank and replenisher)

To prepare 20L **Aufix Fixer** add 5L part A to 14.5L of water and stir for one minute. Now add slowly, under continuous agitation, 0.5L of part B.

Table 2 Mixing instructions fixer

	Fixer & Replenisher solution
Water	14,5 L
Aufix Fix part A	5 L
Aufix Fix part B	0.5 L
End volume	20 L

III. PH AND DENSITY SPECIFICATIONS

Table 3 lists the pH and density specification for fresh working solutions. Seasoned working solutions will slightly increase in density due to evaporation. pH may increase or decrease slightly for both developer and fixer baths while seasoning, depending on the specific customer conditions.

Table 3 pH & Density specifications

	pH (25 °C)	Density (20 °C) g/cm ³
Audel Developer	10.15 ± 0.05	1.073 ± 0.003
Audel Developer Replenisher	10.45 ± 0.05	1.072 ± 0.003
Aufix Fixer & Replenisher	4.45 ± 0.05	1.109 ± 0.003

IV. GENERAL PROCESS SPECIFICATIONS

A. Time and Temperature

Audel Developer and **Aufix Fixer** may be utilised over a wide time and temperature range to suit individual processing conditions available in the market. Typical processing conditions are tabled underneath. FUJIFILM's Industrial X-Ray System is PRATT & WHITNEY approved for long and short processing cycles as shown in table 1.

Table 4 Process specifications

Operating Temperature	Developing Time	Machine Cycle Time
25 °C	150 sec.	11 min (long)
28 °C	100 sec.	8 min (short)

B. Replenishment rates

Industrial X-Ray films generally have a high silver coating weight and depending on manufacturer and film type, substantial differences exist. Differences in application may lead to great variability in overall exposure of the films. Recommended replenishment rates as indicated in table 2 are therefore only intended as a starting point. Replenishment rates should be optimised to fit individual circumstances of exposure, film types and total throughput. If the processor is subject to low film usage or long periods of inactivity, aerial oxidation will occur and it will be necessary to increase developer replenishment rates to maintain adequate activity.

Table 5 Replenishment rates

Average Density (D)	Developer Replenishment	Fixer Replenishment
D < 2.00	450 ml/m ²	1600 ml/m ²
2.00 < D ≤ 3.00	650 ml/m ²	1200 ml/m ²
3.00 < D ≤ 4.00	800 ml/m ²	950 ml/m ²
4.00 < D ≤ 5.00	1100 ml/m ²	650 ml/m ²
D > 5.00	1400 ml/m ²	400 ml/m ²

V. CONTINUOUS ELECTROLYTIC FIXER DESILVERING

In order to reduce the fixer replenishment rate and to reduce silver carry-over into the processor wash tank, FUJIFILM recommends the use of a suitable in-line fixer desilvering unit. With in-line electrolytic desilvering, the silver level of the processor fixing bath should be maintained at 0.3 – 1.0 g of silver per litre.

The electrolytic desilvering capacity of **Aufix Fixer** is limited; saving of a maximum of 30 % in replenishment can be expected.

VI. PROCESSOR TANK CLEANLINESS

If the processor shows signs of dirt or crystal build up on rollers, tank or cross-overs the machine should be emptied, thoroughly washed out and then filled with FUJIFILM **Unicleaner PD** solution. Read the instructions packed with the cleaner before use to avoid damage to machine or chemical reactions. Remember to carefully clean off any deposit on the cross-over mechanism, otherwise scratching of the emulsion may occur.

VII. FILM WASHING

Ensure adequate washing of films is achieved by adhering to the processor manufacturer's recommendations. If an electrolytic fixer desilvering unit is used in a continuous mode with the processor's fixer tank solution, the carry-over of silver into the wash tank will be substantially reduced. This has the benefit of reducing the amount of silver complex in the processor wash water effluent.

VIII. BIOLOGICAL GROWTH IN WASH TANK

Open wash system

It is not usual for biological growth to be found in well-maintained processors with open wash systems and adequate wash water flow rates (1 - 3 litres/minute). If problems are experienced it is best to first have an examination of the water quality and supply system, carried out by a specialist company.

Various biocides compatible with photographic processors are available. FUJIFILM **Algstop LR** is very effective in preventing algae growth during shutdown periods. It is only necessary to add 1 ml of **Algstop LR** concentrate for each litre of wash water capacity to the wash tank at the end of a processing session.

An automatic **Algstop Dosing Unit** is available from FUJIFILM.

Closed, recirculated wash systems

In the low wash water usage and high temperature conditions resulting from recirculation of washwater, it has proven to be difficult to keep bio-growth under control.

For full details on the usage of **Algstop LR**, please ask for the separate FUJIFILM Technical Info Sheets “Algstop”.

Use biocides safely. Always read the label and product information before use !

IX. TROUBLESHOOTING GUIDE

Problem	Possible Cause	Action to be taken
Light Image.	<ol style="list-style-type: none"> 1. Developer temperature too low. 2. Under-replenishment of developer. 3. Exhausted developer. 4. Developer contaminated by fixer. 5. Over-diluted developer. 6. Mixing error. 7. Weak or insufficient exposure. 8. Processing time too short. 9. Too much starter. 	<ol style="list-style-type: none"> 1. Check the temperature with a thermometer and adjust setting. 2. Check replenishment pumps & settings and adjust accordingly. 3. Make new fresh solution. 4. Check mixing procedures - make new fresh solution. 5. Check mixing procedures - make new fresh solution. 6. Check mixing procedures - make new fresh solution. 7. Check equipment used for exposure. 8. Check speed of processor and adjust it if required. 9. Check mixing procedures - make new solution.
Light Image (sudden effect).	Developer contamination* by fixer.	Check mixing procedures - make new developer solution.
Image too dense.	<ol style="list-style-type: none"> 1. Developer temperature too high. 2. Over-replenishment of developer. 3. Processing time too long. 4. Over-exposed film. 5. Insufficient amount of starter. 	<ol style="list-style-type: none"> 1. Check the temperature with a thermometer and adjust settings. 2. Check replenishment rates, pumps & settings and adjust accordingly. 3. Check speed of processor and adjust accordingly. 4. Check equipment used for exposure. 5. Check mixing procedures - make new solution.
Fogged film.	<ol style="list-style-type: none"> 1. Unsuitable darkroom light. 2. Light leak into darkroom. 	<ol style="list-style-type: none"> 1. Follow film manufacturer's recommendations. Safety light must be at distance of 1.2 m min. Check if light bulb is of the correct type. 2. Examine darkroom for light leaks.
Mottles.	Developer rollers are excessively worn or damaged.	Change rollers if thorough cleaning proves to be insufficient.
Film does not dry.	<ol style="list-style-type: none"> 1. Drying temperature too low. 2. Wash-water flow too low. 3. Ineffective fixer. 4. Relative humidity too high. 	<ol style="list-style-type: none"> 1. Check temperature and raise if necessary. 2. Check flow rate & temperature and adjust to standard. 3. Check replenishment rate and adjust accordingly. 4. Dry the air in working area.

Problem	Possible Cause	Action to be taken
White spots on light areas of film.	<ol style="list-style-type: none"> 1. Fixer temperature too low. 2. Under-replenished fixer. 3. Mixing error for fixer. 4. Insufficient wash. 	<ol style="list-style-type: none"> 1. Check with reliable thermometer and adjust accordingly. 2. Check rate of replenishment and adjust as necessary. 3. Check mixing procedure and mixing tank calibration. 4. Check wash flow rate and increase as required.
White transparent spots on films.	<ol style="list-style-type: none"> 1. Spilling or splashing of fixer before processing. 2. Soiled screen. 3. Particles of emulsion lifting from film. 4. Air bubbles between roller and film in developer. 	<ol style="list-style-type: none"> 1. Handle films with care and clean hands. 2. Clean screen. 3. Clean rollers. Check that fixer replenishment rate is sufficient.** 4. Check solution circulation, pump and filter.
Small particles on film.	Dirt in solution.	Check solution circulation, filter and pump.
White or dark halfmoon shaped marks on film.	Film has been folded or bent before processing.	Handle film with care, do not bend.
Parallel black & transparent stripes.	Uneven pressure from distorted rollers in the developer section of the processor.	Clean machine thoroughly - have machine manufacturer check rollers.
Dark black marks.	<ol style="list-style-type: none"> 1. Electrostatic discharge. 2. Pressure applied during handling. 	<ol style="list-style-type: none"> 1. Check relative humidity. 2. Handle films smoothly and with care.
Dark or light spots on film (comet shaped).	Splashing of chemicals (fixer or detergents) before processing.	Clean up working & loading areas.
Soiled film after drying.	Drying temperature too high.	Check temperature and adjust it to recommended value.
White layer on film.	<ol style="list-style-type: none"> 1. Wash flow rate too low. 2. Soiled/exhausted fixer bath. 	<ol style="list-style-type: none"> 1. Check flow rate & temperature of wash water - adjust if needed. 2. Check mixing procedure - prepare new fix solution. Check fix replenishment rate.
Yellow stain on film after storage.	Insufficient fixation.	Ensure fixer** replenishment rate is correct.

Problem	Possible Cause	Action to be taken
Scratches on film.	1. Along the entire length of the film. 2. Along the direction of feed of film into processor (often with round areas of higher density).	1. Guide rails scratching film. Process another film with its long axis at right angles to the direction in which the previous film was processed. This will show whether the scratches occur before loading into processor or during processing. 2. Excessive pressure applied to film by fingers when inserted into feed slot of processor.

* : When filling a processor with developer and fixer solution always mix and install fixer before developer to avoid fixer splashing into developer. Always rinse developer tank and rollers thoroughly with water after installing fixer before installing developer. Use separate mixing tanks.

** : The condition of a fixer can be judged by its silver content. Normally the silver concentration should not exceed 4 g/L. If it is too high this indicates too low a rate of replenishment. Silver concentration can be measured by silver test strips available from various laboratory chemical suppliers or from Merck.

X. STORAGE

Liquid developer and fixer concentrates should be stored above 5°C to prevent crystallisation. Storage temperature above 25°C will cause premature ageing.

XI. HANDLING PROCESSING SOLUTIONS

Always read the hazard information on the packs of solution concentrate before attempting to handle the solutions. Read the MSDS (Material Safety Data Sheets). These are available on request if you do not have a copy.

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. Wash with an acidic soap and rinse thoroughly with water. Consult a medical doctor. Some photographic solutions produce irritating vapours therefore thorough ventilation is essential. Do not inhale air above processing solutions.