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BOOK OF
FORMULAS

*for Eastman
Professional Films
and Plates*

**EASTMAN KODAK COMPANY
ROCHESTER, NEW YORK**

Developers for Eastman Professional Films and Plates and Wratten Plates

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BOOK OF FORMULAS

THE formulas in this book supersede all others published in direction sheets and instruction books to date, relating to Eastman Professional Films and Plates and Wratten and Wainwright Plates. We recommend them to you, confident that they will secure the finest results possible with products of our manufacture.

Photography is so essentially a chemical process, involving the most delicate reactions of chemicals in solution, that the chemical materials used in photographic processes must have—in the greatest degree—purity, strength and uniformity. That is why we make and recommend Eastman Tested Chemicals.

The Eastman alkali, known as Kodalk, has several properties that make it especially suitable for photographic use. It is slightly less alkaline than carbonate and more alkaline than borax. By increasing or decreasing the quantity of Kodalk in a recommended formula, it is possible (a) to increase or decrease the contrast obtained in a given time of development, or (b) to decrease or increase the time of development without affecting the contrast.

Formulas containing Kodalk have the additional advantages: (1) blister formation is eliminated because no gas bubbles are liberated when the developer is brought in contact with the acid hardening bath or acid fixing bath, and (2) scum formation is greatly minimized because Kodalk developers have minimum tendency to precipitate an aluminum sulphite sludge in the acid fixing bath.

Eastman Tested Sodium Sulphite, desiccated (96½% pure) is specified in all Eastman formulas. In those formulas specifying carbonate, we recommend the use of Eastman Tested Sodium Carbonate, desiccated (98½% pure). If monohydrated carbonate is used, the quantities of carbonate given in the formula must be increased 17 per cent.

DEVELOPMENT SUGGESTIONS

General Tray or Tank Use. Formulas DK-50 and D-61a are specially recommended for general portraiture or commercial work. They produce negatives of average contrast free of stain or fog, and have the advantage over pyro in that it is possible to duplicate results readily, whereas with a pyro developer, the degree of stain and, hence, the printing contrast tends to vary from batch to batch of negatives. For "quick finish" work on Eastman Post Card Plates, Formula D-62 should be used.

When low contrast and maximum shadow detail are required, Formula D-76 is recommended. The activity of Formula D-76 can be increased by using more borax, but maximum activity is obtained by substituting Kodalk for borax and increasing the quantity of Kodalk.

Those who prefer pyro developers will find that very satisfactory results can be obtained with Formulas D-1, and D-7. These developers, however, have much poorer keeping properties than any of the Elon-hydroquinone developers. For copy negatives and display transparencies, use special pyro developer, D-84.

Press Work and Process Photography. For press work, when rapid development and fairly high contrast are desired, Formulas D-19 and D-72 are recommended. For extreme underexposures, we recommend the use of Formula D-82 which gives great shadow density. Negatives of very high density as required for line work may be obtained with Formulas D-8 and D-9. Formula D-8 has somewhat better keeping properties than D-9 and is especially recommended for line and halftone screen negatives intended for printing directly on metal. Formula D-11 is recommended for general commercial work and for halftone screen negatives from which positive transparencies are to be made for dot etching.

Photomicrography and Spectroscopy. For low and normal contrast work, Formula D-76c is recommended. Formula D-19 should be used when great contrast is desired.

Lantern Slides. Formula D-72 is recommended for general use with Eastman Soft, Medium, and Contrast Lantern Slides. For line work on Contrast Slides use Formula D-11. Formula D-34 gives blue-black tones and Formula D-32, warm black tones.

Ivory Effects on Kotava Safety Positive Film. Very satisfactory tones will be obtained on Kotava Film by using Formula D-52.

Important: All tank developers, when not in use, should be kept covered with a thin sheet of Kodaloid in the form of a shallow boat which may be floated on the solution to prevent aerial oxidation. After removing the floating lid, the surface of the developer should be skimmed with a blotter.

Developers for Portrait and Commercial Work

Kodak Developer

[Formula
DK-50]

For Normal Contrast on Professional Films and Plates

Stock Solution

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	64 ounces	2.0 liters
Elon	145 grains	10.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	4 ounces	120.0 grams
Hydroquinone	145 grains	10.0 grams
Kodalk	1 oz. 145 grains	40.0 grams
Potassium Bromide	29 grains	2.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

For tank development of SS Panchromatic and Portrait Panchromatic Films take 1 part stock solution and 1 part water. Develop about 9 minutes at 65° F. (18° C.). For tray development, use without dilution and develop about 3½ minutes at 65° F. (18 C.).

For tank development of other films and plates use without dilution and develop about 10 minutes at 65° F. (18° C.), in the fresh developer. For tray development decrease the time 20%.

Greater or less contrast may be obtained by developing for longer or shorter times than those specified.

By increasing or decreasing the quantity of Kodalk in the formula, it is possible (a) to increase or decrease the contrast obtained in a given time of development, or (b) to decrease or increase the development time without affecting the contrast. For example, by doubling the Kodalk, the time of development will be decreased about one-third.

For Eastman Tricolor Panchromatic Plates, use without dilution. Development times in a tank of fresh developer are determined for each emulsion and printed on the directions, packed with the plates.

Replenisher Solution

For Formula DK-50

[Formula
DK-50R]

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	96 ounces	3.0 liters
Elon	290 grains	20.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	4 ounces	120.0 grams
Hydroquinone	1 oz. 145 grains	40.0 grams
Kodalk	5¼ ounces	160.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

Add to the tank as needed to maintain the level of the solution. If the developer solution is diluted 1:1, the replenisher should be diluted in the same proportion.

NOTE. If the quantity of Kodalk is increased in DK-50 over that in the regular formula, it may be necessary to discard some of the developer before adding the replenisher in order to maintain an approximately constant developing time.

[Formula
D-61a]

Elon-Hydroquinone

For General Tray or Tank Use

Stock Solution

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 grams
Elon	45 grains	3.1 grams
Sodium Sulphite, desiccated (E.K.Co.)	3 ounces	90.0 grams
Sodium Bisulphite (E.K.Co.)	30 grains	2.1 grams
Hydroquinone	85 grains	5.9 grams
Sodium Carbonate, desiccated (E.K.Co.)	165 grains	11.5 grams
Potassium Bromide	24 grains	1.7 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

For tray use, take 1 part of stock solution to 1 part of water. Develop for about 7 minutes at 65° F. (18° C.).

For tank use, take 1 part of stock solution and 3 parts of water. At a temperature of 65° F. (18° C.), the development time is about 14 minutes.

While this developer does not produce negatives of warm tone, they have good printing density and quality and the developer has excellent keeping properties. It is one of the most satisfactory developers for continued use and, when kept up to normal volume, will give good results over a period of several weeks.

Replenishment: It is advisable to make up a greater quantity of stock solution than is needed to fill the tank. If the developer in the tank is of normal strength, but the volume of solution has been reduced, add a sufficient quantity of the surplus stock solution diluted 1:3 to fill the tank.

As with all tank developers, when not in use it should be covered with a floating lid or thin Kodaloid cut to the exact size of the tank and floated on the solution. The edges should be turned up to form a shallow boat. The surface of the developer should be skimmed each morning with the aid of a blotter.

If the strength of the solution, as well as the volume, has been reduced, add a sufficient quantity of replenisher (Formula D-61R).

[Formula
D-61R]

Replenisher Solution

For Formula D-61a (Tank Dilution)

Stock Solution A

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	96 ounces	3.0 liters
Elon	85 grains	5.9 grams
Sodium Sulphite, desiccated (E.K.Co.)	6 ounces	180.0 grams
Sodium Bisulphite (E.K.Co.)	55 grains	3.8 grams
Hydroquinone	170 grains	11.9 grams
Potassium Bromide	45 grains	3.1 grams
Cold water to make	1½ gallons	6.0 liters

Stock Solution B

Sodium Carbonate, desiccated (E.K.Co.)	8 ounces	240.0 grams
Water to make	64 ounces	2.0 liters

Dissolve the chemicals in the order given.

For use take 3 parts of A and 1 part of B and add to the tank of developer as needed. Do not mix these solutions until ready to use.

Elon-Hydroquinone-Borax Developer [Formula D-76]

For Low Contrast and Maximum Shadow Detail on Panchromatic Films and Plates and Panatomic Film

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	96 ounces	3.0 liters
Elon	116 grains	8.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	13¼ ounces	400.0 grams
Hydroquinone	290 grains	20.0 grams
Borax, granular (E.K.Co.)	116 grains	8.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

Use without dilution.

For tank use, develop about 20 minutes at 65° F. (18° C.) in the fresh developer. Greater or less contrast may be obtained in a longer or shorter time than that indicated. Develop Eastman Infra-Red Sensitive Plates in a tank about 15 minutes at 65° F. (18° C.).

For tray use, decrease the time about 20 per cent.

A faster working developer may be obtained by increasing the quantity of borax. By increasing the borax about 10 times (from 116 grains to 2 ozs. 290 grains per gallon) (from 8 grams to 80 grams per 4 liters) the development time will be about one-half that of regular D-76. Maximum activity can be obtained by substituting Kodalk for borax and using 290 grains of Kodalk per 32 ounces of developer (20 grams per liter). With this concentration, the contrast of a negative developed for 5 minutes in the more rapid developer will approximate that obtained in 20 minutes in D-76.

Replenisher Solution

For Use with Developer D-76

[Formula D-76R]

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	96 ounces	3.0 liters
Elon	175 grains	12.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	13¼ ounces	400.0 grams
Hydroquinone	1 ounce	30.0 grams
Borax, granular (E.K.Co.)	2 ozs. 290 grains	80.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

Use the replenisher without dilution and add to the tank to maintain the level of the solution.

(See next page)

NOTE: When Kodak is substituted for borax in Formula D-76 and a replenisher is required, it is necessary to substitute Kodak for borax in Formula D-76R as follows:

Kodak Concentration in the Developer		Time of Tank Development	Kodak Concentration in the Replenisher	
Per Liter	Per Gallon	65° F. (18° C.)	Per Liter	Per Gallon
2 grams	116 grains	20 min.	7.5 grams	1 ounce
5 grams	290 grains	10 min.	20.0 grams	2 oz. 290 grains
10 grams	1 oz. 145 grains	7½ min.	40.0 grams	5 oz. 145 grains
20 grams	2 oz. 290 grains	5 min.	*40.0 grams	*5 oz. 145 grains

*Discard some developer before adding replenisher.

With use, the D-76 Developer becomes slightly muddy, due to formation of a suspension of colloidal silver, and the tank usually becomes coated with a thin deposit of silver. Both these effects are harmless, however, and may be ignored.

[**Formula**] **Elon-Hydroquinone Developer**
D-72 **For Lantern Slides and for Press Photography**
on Eastman Panchro-Press and Super Panchro-Press Films
and Ortho Press Films and Plates

Stock Solution

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	45 grains	3.1 grams
Sodium Sulphite, desiccated (E.K.Co.)	1½ ounces	45.0 grams
Hydroquinone	175 grains	12.0 grams
Sodium Carbonate, desiccated (E.K.Co.)	2¼ ounces	67.5 grams
Potassium Bromide	27 grains	1.9 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

For general use: Take 1 part stock solution to 1 part water. Develop about 5 minutes at 65° F. (18° C.) in a tank. Greater or less contrast may be obtained by developing a longer or a shorter time than that indicated. *For tray use,* decrease the time about 20 per cent. For less contrast, dilute 1:2; for greater contrast, use without dilution.

For Soft Lantern Slide Plates take stock solution 1 part, water 4 parts. Develop 2 to 3 minutes at 70° F. (21° C.).

For Medium Lantern Slide Plates take stock solution 1 part, water 2 parts. Develop 1 to 2 minutes at 70° F. (21° C.).

For Contrast Lantern Slide Plates take stock solution 1 part, water 1 part. Develop 3 to 5 minutes at 70° F. (21° C.).

[**Formula**] **Maximum Energy Developer**
D-82 **For Underexposed Negatives**

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	24 ounces	750.0 cc.
Wood Alcohol	1½ fluid ozs.	48.0 cc.
Elon	200 grains	14.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	1¾ ounces	52.5 grams
Hydroquinone	200 grains	14.0 grams
Sodium Hydroxide (Caustic Soda)	125 grains	8.8 grams
Potassium Bromide	125 grains	8.8 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

Develop about 5 minutes in a tray at 65° F. (18° C.).

The prepared developer does not keep more than a few days. If wood alcohol is omitted and the developer is diluted, the solution

is not as active as in the concentrated form. This developer gives the greatest possible density with negatives having a minimum exposure.

Elon-Pyro Tray or Tank Developer [Formula D-7]

For Portrait or Commercial Use

Stock Solution A

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	¼ ounce	7.5 grams
Sodium Bisulphite (E.K.Co.)	¼ ounce	7.5 grams
Pyro	1 ounce	30.0 grams
Potassium Bromide	60 grains	4.2 grams
Cold water to make	32 ounces	1.0 liter

Stock Solution B

Water	32 ounces	1.0 liter
Sodium Sulphite, desiccated (E.K.Co.)	5 ounces	150.0 grams

Stock Solution C

Water	32 ounces	1.0 liter
Sodium Carbonate, desiccated (E.K.Co.)	2½ ounces	75.0 grams

Dissolve the chemicals in the order given.

For tray development, take 1 part A, 1 part B, 1 part C, and 8 parts water. Develop about 8 minutes at 65° F. (18° C.).

For tank development, take 8 ounces (250 cc.) each of A, B and C and add water to make one gallon (4 liters). At a temperature of 65° F. (18° C.), development time is about 10 minutes.

Replenishment: This developer can be used repeatedly for two or three weeks if kept up to its normal strength by adding fresh developer in the proportion of 2 ounces (64 cc.) each of A, B and C to 8 ounces (250 cc.) of water although it is usually necessary to increase the development time as the developer ages.

Three-Solution Pyro Developer [Formula D-1]

For Warm Tones Using Tray or Tank

Stock Solution A

	Avoirdupois	Metric
Sodium Bisulphite (E.K.Co.)	140 grains	9.8 grams
Pyro	2 ounces	60.0 grams
Potassium Bromide	16 grains	1.1 grams
Water to make	32 ounces	1.0 liter

Stock Solution B

Water	32 ounces	1.0 liter
Sodium Sulphite, desiccated (E.K.Co.)	3½ ounces	105.0 grams

Stock Solution C

Water	32 ounces	1.0 liter
Sodium Carbonate, desiccated (E.K.Co.)	2½ ounces	75.0 grams

Dissolve the chemicals in the order given.

Prepare fresh developer for each batch of films.

For tray development, take 1 part of A, 1 part of B, 1 part of C and 7 parts of water. Develop about 6 minutes at 65° F. (18° C.).

For tank development, take 9 ounces each (285 cc.) of A, B and C and add water to make 1 gallon (4 liters). For the 3½-gallon

tank take 32 ounces each of A, B and C and add water to make $3\frac{1}{2}$ gallons. Develop for about 12 minutes at a temperature of 65° F. (18° C.). Any scum that may form on the surface of the developer *must be removed by means of a sheet of blotting paper before developing* or stains will result.

[Formula
D-84]

Special Pyro Tray Developer

For Display Transparencies, Copy Negatives
and Ciné Enlargements

Stock Solution A	Avoirdupois	Metric
Water	24 ounces	750.0 cc.
Sodium Sulphite, desiccated (E.K.Co.)	6 ounces	180.0 grams
Pyro	1 ounce	30.0 grams
Water to make	32 ounces	1.0 liter

Stock Solution B	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Sodium Carbonate, desiccated (E.K.Co.)	4 ounces	120.0 grams
Potassium Bromide	55 grains	3.8 grams

Dissolve the chemicals in the order given.

For use, take one part A, one part B and four parts water. Develop about 4 minutes at 65° F. (18° C.).

Developers for Process Photography

Formulas D-8, D-9, D-11 and D-13 are recommended for process photography where very high contrast and density are required, especially for line work. Formulas D-8 and D-9 should be used at 65° F. (18° C.), *not warmer*, and should never be used colder than 55° F. (13° C.). Formula D-8 has somewhat better keeping properties in an open tray than D-9 and gives a slightly higher density in a shorter time of development. Formula D-11 keeps better than D-8 or D-9 and may be used either for tray or tank development when high but not extreme density is required. Formula D-13 is recommended for tropical use at temperatures to 85° F. (29° C.).

[Formula
D-8]

Single Solution Hydroquinone- Caustic Developer

For Very High Contrast on Process and Panchromatic Process
Films and Plates and on Kodalith Stripping Film (Super Speed)

Stock Solution	Avoirdupois	Metric
Water	96 ounces	3.0 liters
Sodium Sulphite, desiccated (E.K.Co.)	12 ounces	360.0 grams
Hydroquinone	6 ounces	180.0 grams
Sodium Hydroxide (Caustic Soda)	5 ounces	150.0 grams
Potassium Bromide	4 ounces	120.0 grams
Water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

For use, take 2 parts of Stock Solution and 1 part of water. Develop about 2 minutes at 65° F. (18° C.). This formula is

especially recommended for making line and halftone screen negatives intended for printing directly on metal.

Wash thoroughly after developing and before fixing, or stains and dichroic fog will result.

A formula which is slightly less alkaline and gives almost as much density with Panchromatic Process Films and Plates, can be obtained by using $3\frac{3}{4}$ ounces of sodium hydroxide (caustic soda) per gallon of stock solution (112 grams per 4 liters) instead of the quantity given in the formula.

For Kodalith Stripping Film (Super Speed), develop about 2 minutes at 65° F. (18° C.), rinse in the SB-1a Acetic Acid Rinse Bath (page 15) about 5 seconds and fix $1\frac{1}{2}$ minutes in the F-5 Fixing Bath (page 15).

Then immerse in warm water (not over 80° F.) (26° C.) for 2 or 3 minutes and strip the film from the paper support. Manipulation from this point is the same as with wet plates.

Hydroquinone-Caustic Developer [Formula D-9]

For Very High Contrast on
Process and Panchromatic Process Films and Plates
For Tray Development

Stock Solution A

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Sodium Bisulphite (E.K.Co.)	$\frac{3}{4}$ ounce	22.5 grams
Hydroquinone	$\frac{3}{4}$ ounce	22.5 grams
Potassium Bromide	$\frac{3}{4}$ ounce	22.5 grams
Cold water to make	32 ounces	1.0 liter

Stock Solution B

Cold water	32 ounces	1.0 liter
Sodium Hydroxide (Caustic Soda)	$1\frac{3}{4}$ ounces	52.5 grams

Dissolve the chemicals in the order given.

Use equal parts of A and B and develop for not more than 2 minutes at 65° F. (18° C.). Wash thoroughly after development and before fixing, or stains and dichroic fog may result.

Cold water should always be used when dissolving sodium hydroxide (caustic soda) because considerable heat is evolved. If hot water is used, the solution will boil with violence and may cause serious burns if the alkali spatters on the hands or face. Solution A should be stirred thoroughly when the caustic alkali is added to it; otherwise the heavy caustic solution will sink to the bottom.

Elon-Hydroquinone Developer [Formula D-11]

For Process and Panchromatic Process Films and Plates, Infra-Red Process Plates, and Contrast Lantern Slide Plates For Tray or Tank

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	15 grains	1.0 gram
Sodium Sulphite, desiccated (E.K.Co.)	$2\frac{1}{2}$ ounces	75.0 grams
Hydroquinone	130 grains	9.0 grams
Sodium Carbonate, desiccated (E.K.Co.)	365 grains	25.0 grams
Potassium Bromide	73 grains	5.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

When used at 65° F. (18° C.) in either tray or tank, very good contrast will be given in about 5 minutes. If less contrast is desired, the developer should be diluted with an equal volume of water.

Formula D-11 can be used for general commercial photography and for making halftone screen negatives from which positive transparencies are to be made for dot etching.

For Contrast Lantern Slide Plates use without dilution. Develop about 5 minutes in a tray or 6 minutes in a tank at 65° F. (18° C.).

For Infra-Red Process Plates use without dilution. Develop about 8 minutes in a tray at 65° F. (18° C.). Develop a shorter time for less contrast or dilute the developer with water.

[Formula
D-13]

Tropical Process Developer (Kodolon-Hydroquinone)

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	24 ounces	750.0 cc.
Kodolon	75 grains	5.2 grams
Sodium Sulphite, desiccated (E.K.Co.)	1¾ ounces	52.5 grams
Hydroquinone	150 grains	10.5 grams
Sodium Carbonate, desiccated (E.K.Co.)	1¾ ounces	52.5 grams
Potassium Iodide	30 grains	2.1 grams
*Sodium Sulphate, desiccated	1½ ounces	45.0 grams
Water to make	32 ounces	1.0 liter

*If sodium sulphate crystals are used, increase the quantity to 3½ ounces per 32 ounces of developer (105 grams per liter).

Dissolve the chemicals in the order given.

Use without dilution. Develop about 6 to 7 minutes at 85° F. (29° C.), or for proportionately longer times at lower temperatures. Rinse for 30 seconds and immerse for 3 minutes in a 5% formalin solution. Then wash for 1 minute, fix in an acid hardening fixing bath (Formula F-5, page 15) and wash 15 to 20 minutes.

[Formula
D-85]

Kodalith Developer For Kodalith Films, Plates and Papers, and Kodalith Stripping Film (Normal)

For Tank Use

	Avoirdupois	Metric
Water (not over 90° F.) (32° C.)	64 ounces	2.0 liters
Sodium Sulphite, desiccated (E.K.Co.)	4 ounces	120.0 grams
Potassium Metabisulphite	150 grains	10.5 grams
*Boric Acid, Crystals	1 ounce	30.0 grams
Hydroquinone	3 ounces	90.0 grams
Potassium Bromide	90 grains	6.3 grams
Paraformaldehyde (E.K.Co.)	1 ounce	30.0 grams
Water to make	1 gallon	4.0 liters

*Use crystalline boric acid as specified. Powdered boric acid dissolves with great difficulty and its use should be avoided.

Dissolve the chemicals in the order given.

This developer will give extreme density. It should be used at a temperature not higher than 70° F. (21° C.) and not lower than 65° F. (18° C.).

Time of development for line negatives, 1½ to 2 minutes at 65°

F. (18° C.) and for half-tone negatives, not over 2½ minutes at the same temperature. The image should appear slowly in about 30 to 45 seconds, and become strong, clear, and brilliant as the development is completed.

Inspection. When handling dry, unexposed films and during the first 30 seconds of development, a red safelight, Wratten Series 1, should be used in a Wratten Safelight Lamp fitted with a 25-watt bulb.

When development is complete, immerse the film or paper for about 5 seconds in the Acetic Acid Rinse Bath (Formula SB-1a, page 15). Then fix 5 or 10 minutes in an acid hardening fixing bath (Formula F-5, page 15) and wash about 10 minutes.

Developers for Special Use

Low and Normal Contrast Developer [Formula D-76c]

For Wratten M and Metallographic Plates

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	96 ounces	3.0 liters
Elon	116 grains	8.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	13¼ ounces	400.0 grams
Hydroquinone	290 grains	20.0 grams
Borax, granular (E.K.Co.)	116 grains	8.0 grams
**Potassium Iodide, 1% solution	1 dram	4.0 cc.
**Potassium Bromide 2.5% solution	10 drams	40.0 cc.
Cold water to make	1 gallon	4.0 liters

*A 1% solution of potassium iodide is prepared by dissolving 44 grains (3 grams) in a few ounces (cc.) of water and then adding water to make 10 ounces (300 cc.) of solution.

**A 2½% solution of potassium bromide is prepared by dissolving ¼ ounce (7.5 grams) in a few ounces (cc.) of water and then adding water to make 10 ounces (300 cc.) of solution.

Dissolve the chemicals in the order given.

Use without dilution.

Average time of tray development for low contrast will be 5 minutes, and for normal contrast, 6½ minutes at 65° F. (18° C.).

Increase the time given about 25 per cent for tank development.

High Contrast Developer [Formula D-19]

For Wratten Hypersensitive Panchromatic, M. Metallographic, Infra-Red Sensitive, and Spectroscopic Plates, and Panchro-Press Film

Stock Solution

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	64 ounces	2.0 liters
Elon	128 grains	8.8 grams
Sodium Sulphite, desiccated (E.K.Co.)	12 ozs. 360 grains	384.0 grams
Hydroquinone	1 oz. 75 grains	35.2 grams
Sodium Carbonate, desiccated (E.K.Co.)	6 ozs. 180 grains	192.0 grams
Potassium Bromide	300 grains	20.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve the chemicals in the order given.

Use without dilution.

Average time of tray development for high contrast on Wratten M and Metallographic Plates will be 3½ minutes and for very high contrast 6 minutes at 65° F. (18° C.).

For press photography on Panchro-Press Film or Wratten



Hypersensitive Panchromatic Plates, develop $2\frac{1}{2}$ to 4 minutes at 65° F. (18° C.) in a tray according to the contrast desired.

Develop Super Panchro-Press Film about 5 minutes in a tray at 65° F. (18° C.).

Increase the time given about 25 per cent for tank development.

For Eastman Spectroscopic Plates use without dilution and develop about 5 minutes in a tank at 65° F. (18° C.).

For Eastman Infra-Red Sensitive Plates, dilute 1 part Stock Solution to 4 parts water, and develop about 6 minutes in a tank or 5 minutes in a tray at 65° F. (18° C.).

[Formula]
D-62
Elon-Hydroquinone Developer
For Eastman Post Card Plates

Stock Solution

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	55 grains	3.8 grams
Sodium Sulphite, desiccated (E.K.Co.)	1 ounce	30.0 grams
Hydroquinone	$\frac{1}{4}$ ounce	7.5 grams
Sodium Carbonate, desiccated (E.K.Co.)	$1\frac{1}{2}$ ounces	45.0 grams
Potassium Bromide	27 grains	1.9 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

For use take stock solution one part, water one part.

For softer tones take stock solution one part, water two parts.

Develop about 4 to 7 minutes at 65° F. (18° C.) in a tank.

Tropical Development

For best results it is advisable to have the temperature of the solutions as near 65° F. (18° C.) as possible. There are times, however, when it is impossible to do this owing to unusual conditions. This is especially true in tropical countries where the temperatures are high and where it is difficult to obtain fresh, cool water.

To develop films at temperatures up to 90° F. (32° C.) Kodalk Developer, Formula DK-15, is especially recommended. This formula has the following advantages: (1) It is non-blistering because no gas is formed when the developer is added to the acid hardening bath or the acid fixing bath. (2) The development rate changes slowly with time so that on slight overdevelopment the negatives will not be too dense. (3) It has a minimum scumming tendency in conjunction with the average fixing bath.

[Formula]
DK-15
Kodalk Tropical Developer
Non-blistering

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	24 ounces	750.0 cc.
Elon	82 grains	5.7 grams
Sodium Sulphite, desiccated (E.K.Co.)	3 ounces	90.0 grams
Kodalk	$\frac{3}{4}$ ounce	22.5 grams
Potassium Bromide	27 grains	1.9 grams
*Sodium Sulphate, desiccated	$1\frac{1}{2}$ ounces	45.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

*If it is desired to use sodium sulphate crystals instead of desiccated sulphate, use $3\frac{1}{2}$ ounces per 32 ounces of developer (105 grams per liter).

At normal temperatures of 65° F. to 75° F. (18° C. to 24° C.), development will be more rapid if the sodium sulphate is omitted, but it should always be used when working above 75° F. (24° C.).

Average time for tank development *without* the sulphate is 5 to 7 minutes and *with* the sulphate 9 to 12 minutes at 65° F. (18° C.) in the fresh developer according to the contrast desired. Develop about 20% less for tray use.

By increasing or decreasing the quantity of Kodalk in the formula, it is possible (a) to increase or decrease the contrast obtained in a given time of development or (b) to decrease or increase the time of development without affecting the contrast. Prolonging the development time, however, *is very undesirable*, as excessive swelling and softening of the gelatin will occur.

Approximate times of development at 80° F. to 90° F. (26.5° C. to 32° C.) are from 5 minutes at 80° F. (26.5° C.) to 2½ minutes at 90° F. (32° C.).

After development, rinse the films not more than 1 second in water (omit water rinse above 85° F.) (29.5° C.), and immerse directly in the Tropical Hardener (Formula SB-4) for 3 minutes. Then fix in Formula F-5, page 15, for at least 10 minutes and wash for 10 to 15 minutes in water not over 95° F. (35° C.).

The following formula will also give satisfactory results under tropical conditions:

Kodelon Tropical Developer

[Formula
D-91]

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	24 ounces	750.0 cc.
Kodelon	100 grains	7.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	1 oz. 290 grains	50.0 grams
Sodium Carbonate, desiccated (E.K.Co.)	1 oz. 290 grains	50.0 grams
Water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

Average time of development, 7 to 9 minutes at 65° F. (18° C.) and 2 to 3 minutes at 90° F. (32° C.) in the fresh developer according to the contrast desired. Rinse, harden, fix, and wash as recommended for Formula DK-15, page 12.

Further details on handling films under high temperature conditions are included in our booklet "Tropical Development," obtainable on request.

Tropical Hardening Bath

[Formula
SB-4]

For Use at 75° F. to 90° F. (24° C. to 32° C.)

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Chrome Alum	1 ounce	30.0 grams
*Sodium Sulphate, desiccated	2 ounces	60.0 grams

*If it is desired to use sodium sulphate crystals instead of the desiccated sulphate, then 4 ounces per 32 ounces of hardener (120 grams per liter) should be used.

Agitate the negatives for 30 to 45 seconds when first immersing in the hardening bath, or streakiness will result. Leave them in the

bath for at least 3 minutes between development and fixation. After the equivalent of twenty 8 x 10-inch films or plates per gallon (4 liters) have been processed, the bath should be replaced. If overworked, scum markings will result.

Lantern Slide Developers*

[Formula] D-34

Elon-Hydroquinone Developer

For Blue-Black Tones

Stock Solution A	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	60 grains	4.2 grams
Sodium Sulphite, desiccated (E.K.Co.)	½ ounce	15.0 grams
Hydroquinone	½ ounce	15.0 grams
Cold water to make	32 ounces	1.0 liter

Stock Solution B	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Sodium Carbonate, desiccated (E.K.Co.)	½ ounce	15.0 grams
Potassium Bromide	30 grains	2.1 grams

Dissolve the chemicals in the order given.

For use take stock solution A, 1 part, stock solution B, 1 part. For softer tones take equal parts of A, B, and water.

Develop 1½ to 3 minutes at 70° F. (21° C.) according to the contrast desired.

[Formula] D-32

Hydroquinone-Caustic Developer

For Warm-Black Tones

Stock Solution A	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Sodium Sulphite, desiccated (E.K.Co.)	90 grains	6.3 grams
Hydroquinone	100 grains	7.0 grams
Potassium Bromide	50 grains	3.5 grams
Citric Acid	10 grains	0.7 gram
Cold water to make	32 ounces	1.0 liter

Stock Solution B	Avoirdupois	Metric
Cold water	32 ounces	1.0 liter
Sodium Carbonate, desiccated (E.K.Co.)	1 ounce	30.0 grams
Sodium Hydroxide (Caustic Soda)	60 grains	4.2 grams

Dissolve the chemicals in the order given.

For use take equal parts of A and B. For still warmer tones take one part A and two parts B.

Develop about 5 minutes at 70° F. (21° C.).

[Formula] D-52

Elon-Hydroquinone Developer

For Kotava Safety Positive Film

Stock Solution	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	16 ounces	500.0 cc.
Elon	22 grains	1.5 grams
Sodium Sulphite, desiccated (E. K. Co.)	¾ ounce	22.5 grams
Hydroquinone	90 grains	6.3 grams
Sodium Carbonate, desiccated (E.K.Co.)	½ ounce	15.0 grams
Potassium Bromide	22 grains	1.5 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the chemicals in the order given.

For use take stock solution 1 part, water 1 part.

Develop not less than 1½ minutes at 70° F. (21° C.).

*See also recommendation for use of Formulas D-72 (page 6) and D-11 (page 9).

Immediately after development immerse the positive in the acetic acid stop bath, (Formula SB-1) for at least 5 seconds and then place directly into the fixing bath.

After fixing, wash the film thoroughly in running water for 20 minutes and dry in the usual manner.

Rinse and Hardening Baths

Acetic Acid Rinse Bath

[Formula
SB-1]

Water	Avoirdupois	Metric
32 ounces	1.0 liter	
*Acetic Acid (28% pure) (E.K.Co.)	1 1/2 fluid ozs.	48.0 cc.

*To make 28% acetic acid from glacial acetic acid, dilute 3 parts glacial acetic acid with 8 parts water.

This bath is recommended for use with all Eastman photographic papers and for Kodava Safety Positive Film between development and fixation. Its action immediately checks development and prevents staining troubles. Move and separate prints while in the rinse bath to insure thorough access of the solution to all parts of every print.

Acetic Acid Rinse Bath

For Kodalith Films, Plates and Papers

[Formula
SB-1a]

Water	Avoirdupois	Metric
1 gallon	4.0 liters	
*Acetic Acid (28% pure) (E.K.Co.)	16 fluid ozs.	500.0 cc.

*To make 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water. When development is complete, remove the negatives promptly from the developer and submerge them in the following rinse bath. The action of this bath instantly checks development, and prevents the formation of many staining troubles.

Chrome Alum Hardening Bath

[Formula
SB-3]

In hot weather, the following hardening bath should be used after development and before fixation in conjunction with Formula F-5 or when F-16 does not harden sufficiently.

Water	Avoirdupois	Metric
32 ounces	1.0 liter	
Potassium Chrome Alum	1 ounce	30.0 grams

Agitate the negatives for a few seconds when first immersed in hardener. Leave them in the bath for three minutes. This bath should be renewed frequently.

Fixing Baths

Acid Hardening Fixing Bath

For General Use with Films and Plates

[Formula
F-5]

Water (about 125° F.) (52° C.)	Avoirdupois	Metric
80 ounces	2.5 liters	
Sodium Thiosulphate (Hypo)	2 pounds	960.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	2 ounces	60.0 grams
*Acetic Acid (28% pure) (E.K.Co.)	6 fluid ozs.	190.0 cc.
**Boric Acid, Crystals	1 ounce	30.0 grams
Potassium Alum (E.K.Co.)	2 ounces	60.0 grams
Cold water to make	1 gallon	4.0 liters

*To make 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

**Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty and its use should be avoided.

Dissolve the chemicals in the order given.

(See next page)

Films and plates will be fixed properly in 10 minutes if a freshly prepared fixing bath has been used. Leaving them in the solution a few minutes longer than the time specified will not do any harm, but prolonged immersion, especially in warm weather, is harmful.

When the total fixing time (twice the time to clear) for a slow fixing film or plate, exceeds 20 minutes, the bath should be discarded. This will usually occur after approximately eighty to one hundred 8 x 10-inch films or plates or their equivalent have been fixed per gallon (4 liters). The bath gives good hardening and should not sludge throughout its useful life.

[**Formula**
F-5a] **Acid Hardener Stock Solution**
For Use with Formula F-5

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	30 ounces	2.5 liters
Sodium Sulphite, desiccated (E.K.Co.)	10 ounces	300.0 grams
*Acetic Acid (28% pure) (E.K.Co.)	30 fluid ozs.	940.0 cc.
**Boric Acid, Crystals	5 ounces	150.0 grams
Potassium Alum (E.K.Co.)	10 ounces	300.0 grams
Cold water to make	1 gallon	4.0 liters

*To make 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

**Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty and its use should be avoided.

Dissolve the chemicals in the order given.

A fixing bath is made by adding one part of cool stock hardener solution to four parts of cool 30 per cent hypo solution (2½ lbs. hypo per gallon of water) (300 grams per liter) while stirring the hypo rapidly.

[**Formula**
F-16] **Chrome Alum Fixing Bath**
For General Use with Films and Plates

Solution A

	Avoirdupois	Metric
Sodium Thiosulphate (Hypo)	2 pounds	960.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	2 ounces	60.0 grams
Water to make	96 ounces	3.0 liters

Solution B

Water (not above 125° F.) (52° C.)	32 ounces	1.0 liter
Potassium Chrome Alum	2 ounces	60.0 grams
Sulphuric Acid, C. P. (E.K.Co.)	¼ fluid oz.	8.0 cc.

Dissolve the chemicals in the order given.

Pour solution B into solution A slowly while stirring A rapidly.

Always rinse the films thoroughly before fixing. This bath is recommended for use in hot weather.

A fresh bath should be prepared frequently because a chrome alum bath often loses its hardening properties in a few days either with or without use, while with an old bath there is a tendency for scum to form on the surface of the film. Any such scum should be removed by swabbing with cotton before drying.

Formula F-5 (page 15) maintains the hardening properties throughout the useful life of the bath and also has a minimum sludging tendency.

The Importance of Agitation

When processing films (or plates) in tanks it is important to agitate the films during treatment in the various solutions. Agitation during development insures uniform development with freedom from mottle, airbells, and streakings. The films should also be agitated when first placed in the fixing bath in order to arrest development and minimize the tendency for streaks and mottle. It is not desirable to rock the tank itself as it is almost impossible to produce uniform agitation of the solution at all parts of the film in this way. If streaks are encountered, moving the hangers themselves is absolutely necessary.

Agitation of a batch of films is greatly simplified by using the Eastman Film Developing Hanger Rack. After loading the rack with film hangers, lower it into the developer. Then raise each hanger separately about $\frac{1}{2}$ inch and tap it sharply several times on the side of the rack. This dislodges any airbells which may cling to it. After developing for 1 minute, lift the entire Hanger Rack out of the solution and immerse again. Then allow development to go to completion.

Washing Films and Plates

When fixed, the films or plates should be removed to the washing tray or tank. To wash thoroughly, it is necessary to insure a constant supply of fresh water at the surface of the film, and that the water in the washing tank is renewed frequently. Washing conditions vary so widely in practice that it is quite difficult to recommend specific washing times but fairly complete removal of the hypo can be insured by 20 to 30 minutes washing. Thorough washing will result if the water in the tank is replaced completely about six times every 30 minutes. To test for completeness of washing, use the following solution:

Hypo Test Solution

[Formula
HT-1a]

	Avoirdupois	Metric
Distilled water	6 ounces	180.0 cc.
Potassium Permanganate	4 grains	0.3 gram
Sodium Hydroxide (Caustic Soda)	8 grains	0.6 gram
Water (distilled) to make	8 ounces	250.0 cc.

Take 8 ounces (250 cc.) of pure water in a clear glass and add $\frac{1}{4}$ dram (1 cc.) of the Hypo Test Solution. Then take one 8 x 10-inch film or plate, or its equivalent in other sizes (two 5 x 7-inch or four 4 x 5-inch, etc.), from the wash water and allow the water to drip for 30 seconds from its surface into the glass containing the Hypo Test Solution.

If a small percentage of hypo is present the violet color will change to orange in *about 30 seconds*, and with larger concentrations of hypo the orange color will change to yellow. In either case the washing should be continued. When further tests produce no change in the violet color, this indicates that the hypo content has been reduced to a safe margin, thereby insuring satisfactory permanency.

NOTE: Oxidizable organic matter if present in the water reacts with the permanganate solution and changes its color in the same manner as hypo. The water should, therefore, be tested as follows:

Prepare two samples of permanganate test solution, using distilled water. Then add a volume of the tap water to one test sample equal to that of the wash water drained from the plate into the other sample. If the sample to which tap water has been added remains a violet color, this indicates the absence of organic matter and it will be unnecessary to make the test in duplicate. If the color is changed slightly by the tap water, however, the presence of hypo in the plate will be shown by the relative color change of the two samples. For example, if the tap water sample turned pink and the wash water sample became yellow, it would indicate the presence of hypo while if both turned the same shade this would indicate the absence of hypo.

Hardening of Negatives for After-Treatment

Most of the processes of chemical reduction, intensification and stain removal have a softening action on the gelatin unless precautions are taken to harden the negative previous to after-treatment. The following hardening bath, (Formula SH-1) is recommended especially for negatives which are to receive after-treatment:

[**Formula
SH-1**]

Formalin Hardener

For all Professional Films and Plates

Formalin (40% Formaldehyde solution)	Avoirdupois 2½ drams	Metric 10.0 cc.
Sodium Carbonate, desiccated (E.K.Co.)	70 grains	5.0 grams
Water to make	32 ounces	1.0 liter

After hardening for 3 minutes, negatives should be rinsed and immediately immersed for 5 minutes in a fresh acid fixing bath and washed thoroughly before given any further chemical treatment.

Intensifying and Reducing

If films or plates need intensification or reduction, it is best to give them such treatment immediately after they have been washed. Much time is saved and the negatives, when dry, are ready for finishing.

Precautions: Stains are sometimes produced during intensification or reduction unless the following precautions are observed: (1) The negative should be fixed and washed thoroughly before treatment and be free of scum or stain. (2) It should be hardened in the formalin hardener (SH-1) before the intensification or reduction treatment. (3) Only one negative should be handled at a time and it should be agitated thoroughly during the treatment.

Following the treatment, the negative should be washed thoroughly and wiped off carefully before drying.

Intensifier Solutions

Mercury Intensifier

[Formula
In-1]

For all Professional Films and Plates

Bleach the negative in the following solution until it is white, then wash thoroughly:

	Avoirdupois	Metric
Potassium Bromide	¾ ounce	22.5 grams
Mercuric Chloride	¾ ounce	22.5 grams
Water to make	32 ounces	1.0 liter

The negative can be blackened with any one of the following solutions, each giving progressively greater density in the order given: (1) a 10% sodium sulphite solution; (2) a developing solution, such as Formula D-72 (see page 6), diluted 1 to 2; or (3) 10% ammonia, (1 part concentrated 28% ammonia to 9 parts water).

To increase contrast greatly, treat with the following:

Solution A

	Avoirdupois	Metric
Water	16 ounces	500.0 cc.
*Sodium or Potassium Cyanide	½ ounce	15.0 grams

Solution B

	Avoirdupois	Metric
Water	16 ounces	500.0 cc.
Silver Nitrate, Crystals (E.K.Co.)	¾ ounce	22.5 grams

***Warning:** Cyanide is a deadly poison and should be handled with extreme care. It reacts with acid to form poisonous hydrogen cyanide gas. When discarding a solution containing cyanide, always run water to flush it out of the sink quickly. Cyanide solutions should never be used in poorly ventilated rooms.

To prepare the intensifier add the silver nitrate solution (B) to the cyanide solution (A) until a permanent precipitate is just produced; allow the mixture to stand a short time and then filter. This is called *Monckhoven's Intensifier*.

Note: See precautions on handling negatives, page 18.

Chromium Intensifier

[Formula
In-4]

For all Professional Films and Plates

Stock Solution

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Bichromate	3 ounces	90.0 grams
Hydrochloric Acid, C. P. (E.K.Co.)	2 fluid ozs.	64.0 cc.

For use, take 1 part of stock solution to 10 parts of water. Harden the negative with an alkaline solution of formalin

(Formula SH-1, page 18) before treatment with the chromium intensifier, or the gelatin may reticulate and ruin the negative.

Bleach thoroughly at 65° F. (18° C.), then wash five minutes and redevelop fully (about 5 minutes) in artificial light or daylight (not sunlight) in a non-staining developer such as Formula D-61a (page 4) diluted 1:3. If the negative is not redeveloped fully then fix for five minutes, and wash thoroughly. Fixing is unnecessary if redevelopment is thorough. The degree of intensification may be controlled by varying the time of redevelopment. Greater intensification can be secured by repetition.

The degree of intensification can be controlled by varying the time of redevelopment. The *Eastman Chromium Intensifier*, supplied in tubes is equally as satisfactory as Formula In-4.

***Warning:** Developers, such as Formula D-76, containing a high concentration of sulphite, are not suitable for redevelopment, since the sulphite tends to dissolve the bleached image before the developing agents have time to act on it.

Negatives intensified with chromium are more permanent than those intensified with mercury.

Note: See precautions on handling negatives, page 18.

[Formula
In-5]

Silver Intensifier

For all Professional Films and Plates

This is the only known intensifier which gives an image of neutral color. The progress of intensification may be followed visually and arrested at any stage.

Stock Solution No. 1 (Store in a brown bottle)

Silver Nitrate, Crystals (E.K.Co.)	2 ounces	60.0 grams
Water, distilled, to make	32 ounces	1.0 liter

Stock Solution No. 2

Sodium Sulphite, desiccated (E.K.Co.)	2 ounces	60.0 grams
Water to make	32 ounces	1.0 liter

Stock Solution No. 3

Sodium Thiosulphate (Hypo)	3½ ounces	105.0 grams
Water to make	32 ounces	1.0 liter

Stock Solution No. 4

Sodium Sulphite, desiccated (E.K.Co.)	½ ounce	15.0 grams
Elon	350 grains	24.0 grams
Water to make	96 ounces	3.0 liters

The intensifier solution is prepared as follows:

Slowly add one part of Solution No. 2 to one part of Solution No. 1, shaking or stirring to obtain thorough mixing. The white precipitate which appears is then dissolved by the addition of one part of Solution No. 3. Allow the resulting solution to stand a few minutes until clear. Add, with stirring, 3 parts of Solution No. 4. The intensifier is then ready for use and the film should

be treated immediately. The degree of intensification obtained depends upon the time of treatment which should not exceed 25 minutes. After intensification the film should be immersed and agitated for 2 minutes in a plain 30% hypo solution and then washed thoroughly.

The mixed intensifier is stable for approximately 30 minutes at 70° F. (21° C.).

Note: See precautions on handling negatives, page 18.

Reducers

Reducers may be classified as follows:

A. Subtractive or cutting reducers for correcting overexposure.

R-2 Acid Permanganate.

R-4a Farmer's Reducer (Ferricyanide-Hypo).

Iodine-Cyanide Reducer.

B. Proportional Reducers for correcting over-development.

R-4b Two Solution Farmer's Reducer.

R-5 Persulphate-Acid Permanganate.

R-8 Modified Belitzski (also a cutting reducer).

C. SuperProportional Reducer for correcting over-developed negatives of contrasty subjects.

R-1 Acid-Persulphate.

Persulphate Reducer

For Over-developed Negatives of Contrasty Subjects

[Formula
R-1]

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Ammonia Persulphate	2 ounces	60.0 grams
*Sulphuric Acid, C.P. (E.K.Co.)	3/4 dram	3.0 cc.

For use take 1 part of stock solution and 2 parts of water.

When reduction is complete immerse in an acid fixing bath for a few minutes, then wash.

Permanganate Reducer

For Correcting Overexposed Negatives

[Formula
R-2]

Stock Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Permanganate	1 3/4 ounces	52.5 grams

Stock Solution B

Water	32 ounces	1.0 liter
*Sulphuric Acid, C.P. (E.K.Co.)	1 fluid oz.	32.0 cc.

*Warning: Always add concentrated sulphuric acid slowly to the water with stirring—never the water to the acid; otherwise the solution may boil and spatter the strong acid on the hands and face causing serious burns.

The negative must be washed thoroughly to remove all traces

of hypo before it is reduced. *For use* take 1 part A, 2 parts B and 64 parts of water. When the negative has been reduced sufficiently place it in a fresh Acid Fixing Bath (Formula F-5, page 15) for a few minutes, to remove yellow stains, then wash thoroughly.

If reduction is too rapid, use a larger volume of water when diluting the solution for use.

Important: This solution should *not be used* as a stain remover as it has a tendency to attack the image before it removes the stain. Use Formula S-6 on page 24 for removing developer stains.

NOTE: If a scum forms on the top of the permanganate solution or a reddish curd appears in the solution, it is because the negative has not been sufficiently washed to remove all hypo. or because the permanganate solution has been contaminated by hypo. The separate solutions will keep and work perfectly for a considerable time if proper precautions against contamination are observed. The two solutions should not be combined until immediately before they are to be used. They will not keep long in combination.

A close observance of the foregoing instructions is important. Otherwise, an iridescent scum will sometimes appear on the reduced negatives after they are dry, and this is difficult, if not impossible, to remove.

[Formula
R-4a]

Farmer's Reducer

For Correcting Overexposed Negatives

Stock Solution A

	Avoirdupois	Metric
Water	16 ounces	500.0 cc.
Potassium Ferricyanide	1¼ ounces	37.5 grams

Stock Solution B

Water	64 ounces	2.0 liters
Sodium Thiosulphate (Hypo)	16 ounces	480.0 grams

For use take: Stock solution A, 1 ounce (30 cc.), stock solution B, 4 ounces (120 cc.), and water to make 32 ounces (1 liter). Add A to B, then add the water.

Pour the mixed solution at once over the negative to be reduced. Watch closely. The action is best seen when the solution is poured over the negative in a white tray. When the negative has been reduced sufficiently, wash thoroughly before drying.

Solutions A and B should not be combined until they are to be used. They will not keep long in combination.

Farmer's Reducer also may be used as a two-solution formula by treating the negative in the ferricyanide solution first and subsequently in the hypo solution. This method has the advantage of giving almost proportional reduction and correcting for overdevelopment. The single solution Farmer's Reducer gives only cutting reduction and corrects for overexposure.

Two-Solution Farmer's Reducer

For Correcting Over-developed Negatives

[Formula
R-4b]

Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Ferricyanide	¼ ounce	7.5 grams

Solution B

Water	32 ounces	1.0 liter
Sodium Thiosulphate (Hypo)	6¾ ounces	200.0 grams

Treat the negatives in Solution A with uniform agitation for 1 to 4 minutes at 65-70° F. (18-21° C.) depending on the degree of reduction desired. Then immerse them in Solution B for 5 minutes and wash thoroughly. The process may be repeated if more reduction is desired. For the reduction of general fog, one part of Solution A should be diluted with one part of water.

Proportional Reducer

For Correcting Over-developed Negatives

[Formula
R-5]

Stock Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Permanganate	4 grains	0.3 gram
*Sulphuric Acid (10% solution)	½ fluid oz.	16.0 cc.

Stock Solution B

Water	96 ounces	3.0 liters
Ammonium Persulphate	3 ounces	90.0 grams

*To make a 10% solution of sulphuric acid, take 1 part of Sulphuric Acid, C.P. (E.K.Co.) and add it to 9 parts of water, slowly with stirring.

For use, take 1 part of A to 3 parts of B. When sufficient reduction is secured the negative should be cleared in a 1% solution of sodium bisulphite. Wash the negative thoroughly before drying.

Modified Belitzski Reducer

For Correcting Overexposed and
Over-developed Negatives

[Formula
R-8]

This reducer is the only known single solution reducer which keeps well in a tank. It is especially recommended for treatment of dense, contrasty negatives.

	Avoirdupois	Metric
Water (about 125° F.) (52° C.)	24 ounces	500.0 cc.
Ferric Chloride, Crystals	365 grains	25.0 grams
*Potassium Citrate	2½ ounces	75.0 grams
Sodium Sulphite, desiccated (E.K.Co.)	1 ounce	30.0 grams
Citric Acid	290 grains	20.0 grams
Sodium Thiosulphate (Hypo)	6¾ ounces	200.0 grams
Water to make	32 ounces	1.0 liter

*Sodium citrate should not be used in place of potassium citrate because the rate of reduction is slowed up considerably.

Dissolve the chemicals in the order given and follow directions on page 24.

Use the reducer solution full strength for maximum rate of reduction. Treat the negatives for 1 to 10 minutes at 65° to 70° F. (18° to 21° C.). Then wash thoroughly. If a slower action is desired, dilute one part of the solution with one part of water.

Iodine-Cyanide Reducer

A very powerful subtractive reducer is made from a solution of iodine in potassium iodide, to which potassium cyanide has been added to dissolve the silver iodide formed during reduction. To make up a reducer, dissolve 5 parts iodine crystals in 100 parts of a 10 per cent solution of potassium iodide. Then dissolve 1 part of sodium or potassium cyanide in 10 parts of the iodine-iodide solution and make up to 100 parts with water. The activity of the reducer may be decreased by diluting with water. This solution may be used for reducing either bromide prints or negatives. For less active reduction, the reducer may be diluted with water.

Wash thoroughly after the reduction treatment. Negatives should preferably be hardened with the Formalin Hardener (SH-1, page 18) previous to the treatment.

Warning: Cyanide is a deadly poison and should only be handled in a well ventilated room. Solution containing cyanide should never be discarded in a sink containing acid or poisonous hydrogen cyanide gas will be formed. The sink should be well washed out with water after discarding the cyanide solution.

Stain Remover and Tray Cleaners

[Formula
S-6]

Stain Remover

For all Professional Films and Plates

Developer or oxidation stain may be removed by first hardening the film for 2 or 3 minutes in the Formalin Hardener Solution (Formula SH-1, page 18), then washing for 5 minutes and bleaching in:

Stock Solution A

Water	Avoirdupois	Metric
Potassium Permanganate	32 ounces	1.0 liter
	75 grains	5.3 grams

Stock Solution B

Water	Avoirdupois	Metric
Sodium Chloride (Table Salt)	32 ounces	1.0 liter
Sulphuric Acid, C.P. (E.K.Co.)	2½ ounces	75.0 grams
	½ fluid oz.	16.0 cc.

Use equal parts of A and B. The solutions should not be mixed until ready for immediate use since they do not keep long after mixing. All particles of permanganate should be dissolved completely when preparing Solution A, since undissolved particles are

likely to produce spots on the negative. Bleaching should be complete in 3 or 4 minutes at 65° F. (18° C.). The brown stain of manganese dioxide formed in the bleach bath is best removed by immersing the negative in 1% sodium bisulphite solution. Then rinse well and develop in strong light (except direct sunlight), with any non-staining developer such as Formula D-72 diluted 1 part to 2 parts of water (see page 6).

Warning: Developers containing a high sulphite and low alkali concentration (such as D-76) should not be used for redevelopment because the sulphite tends to dissolve the silver image before the developing agents have had time to act upon it.

Acid Bichromate Tray Cleaner [Formula TC-1]

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Bichromate	3 ounces	90.0 grams
Sulphuric Acid, C.P. (E.K.Co.)	3 fluid ozs.	96.0 cc.

Add the sulphuric acid slowly to the bichromate solution when mixing; never add the bichromate solution or the water to the acid or the solution will boil and may spatter on the hands or face causing serious burns.

For use: Pour a small volume of the tray cleaner solution into the vessel to be cleaned. Rinse around so that it has access to all parts, then pour the solution out and wash the tray six or eight times with water until all traces of the cleaning solution disappear. This tray cleaner is a corrosive solution. It should be discarded after use and *not* left in the tray.

Acid Permanganate Tray Cleaner [Formula TC-2]

For Removal of Silver Stains

Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Permanganate	73 grains	5.0 grams
*Sulphuric Acid, C.P. (E.K.Co.)	2½ drams	10.0 cc.

*Add the sulphuric acid slowly while stirring the permanganate solution rapidly.

Solution B

Water	32 ounces	1.0 liter
Sodium Bisulphite (E.K.Co.)	145 grains	10.0 grams

Pour solution A into the tray and allow it to remain for a few minutes; then rinse with water. Apply solution B, and wash thoroughly.

This formula is recommended especially for the removal of several types of silver stains from enamelled trays. It is also satisfactory for general use.

Weights and Measures—Conversion Tables

In photographic practice, solids are weighed and liquids are measured either by the Avoirdupois or the Metric system.

The following tables of weights and measures give all the equivalent values required for converting photographic formulas:

Avoirdupois to Metric Weight

Pounds	Ounces	Grains	Grams	Kilograms
1	16	7000	453.6	0.4536
0.0625	1	437.5	28.35	0.02835
	$\frac{1}{16}$	1	0.0648	
	0.03527	15.43	1	0.001
2.205	35.27	15430	1000	1

U. S. Liquid to Metric Measure*

Gallons	Quarts	Ounces (Fluid)	Drams (Fluid)	Cubic Centimeters	Liters
1	4	128	1024	3785	3.785
0.25	1	32	256	946.3	0.9463
		1	8	29.57	0.02957
0.000975	0.0039	0.125	1(60 mins.)	3.697	0.003697
		0.03381	0.2705	1	0.001
0.2642	1.057	33.81	270.5	1000	1

Solid Conversion Values

Grains per 32 ozs.	multiplied by 0.06847	=grams per liter
Ounces per 32 ozs.	multiplied by 29.96	=grams per liter
Pounds per 32 ozs.	multiplied by 479.3	=grams per liter
Grams per liter	multiplied by 14.60	=grams per 32 ozs.
Grams per liter	multiplied by 0.03338	=ounces per 32 ozs.
Grams per liter	multiplied by 0.002086	=pounds per 32 ozs.

Liquid Conversion Values*

(U. S. System)

Ounces (fluid) per 32 ozs. multiplied by 31.25 = cubic centimeters per liter.
Cubic centimeters per liter multiplied by 0.032 = ounces (fluid) per 32 ozs.

*These tables do not apply when converting British Imperial liquid measure to metric measure.

When a formula is expressed in grains, ounces, and pounds, it may be converted into a metric formula by using the conversion tables above, which take into account the difference between 32 ounces and one liter. After a conversion has been made, the values obtained should be rounded off to give convenient working quantities. The error introduced in rounding off a value should not be greater than 3 per cent and the ratio between chemicals such as Elon and hydroquinone, or carbonate and sulphite should not be changed.

Thus a developer formula for a 3½-gallon tank would be converted as follows:

Formula

Water (about 125° F.) (52° C.)		1	gallon
Elon		149	grains
Sodium Sulphite, desiccated (E.K.Co.)	10 ounces	240	grains
Sodium Bisulphite (E.K.Co.)		96	grains
Hydroquinone		288	grains
Sodium Carbonate, desiccated (E.K.Co.)	1 ounce	139	grains
Potassium Bromide		83	grains
Cold water to make		3½	gallons

Conversion to 1 Gallon (Avoirdupois)

	Direct	Rounded Off
Water (about 125° F.)	32 ounces	32 ounces
Elon	42½ grains	43 grains
Sodium Sulphite, desiccated (E.K.Co.)	3 ozs. 4 grains	3 ounces
Sodium Bisulphite (E.K.Co.)	27½ grains	28 grains
Hydroquinone	82¼ grains	82 grains
Sodium Carbonate, desiccated (E.K.Co.)	165 grains	165 grains
Potassium Bromide	23¾ grains	24 grains
Cold water to make	1 gallon	1 gallon

Conversion to 4 Liters (Metric)

Water (about 52° C.)	1.0 liter	1.0 liter
Elon	2.91 grams	2.9 grams
Sodium Sulphite, desiccated (E.K.Co.)	90.07 grams	90.0 grams
Sodium Bisulphite (E.K.Co.)	1.88 grams	1.9 grams
Hydroquinone	5.64 grams	5.6 grams
Sodium Carbonate, desiccated (E.K.Co.)	11.28 grams	11.3 grams
Potassium Bromide	1.62 grams	1.6 grams
Cold water to make	4.0 liters	4.0 liters

To convert a metric formula into an avoirdupois formula, the process should be reversed using the values given in the second part of the foregoing conversion table. Values in grains should be rounded off to the nearest quarter ounce, whenever it is possible to do so without introducing an error greater than 3 per cent.

The Measurement of Volumes of Solution

It is often recommended to dissolve, say, 10 parts of a solid in 100 parts of water. In the case of liquids, parts should be taken as meaning units of volume and in the case of solids as units of weight. A "part" may, therefore, mean anything from a grain to a ton, or a minim to a gallon so long as the other quantities are reckoned in the same units of weight or volume. Thus:

For Use, take		For Use, take
Solution A..... 3 parts	} may mean	(Solution A..... 15 ozs.
Solution B..... 1 part		(Solution B..... 5 ozs.

If the formula contains both solids and liquids, if ounces (liquid) and ounces (solid) are substituted for "parts," the error

involved falls within permissible limits. See the example below:

Mix one gallon of solution according to the following formula:

Sodium Sulphite 10 parts; Pyro 1 part; Water to make 100 parts

One gallon equals 128 ozs. Therefore, dissolve $10 \times 128 \div 100 = 12 \frac{4}{5}$ ozs. of sulphite in water, add $1 \frac{1}{4}$ ozs. of Pyro, and make up to 1 gallon.

When quantities of chemicals under 10 grains or 0.7 gram are included in a formula, they are expressed preferably as a 10 per cent solution to be added as so many drams or cc. If less than a dram is required, an even quarter fraction thereof ought to be used. This plan avoids expressing the volume in "drops," which is a very uncertain quantity varying as much as 150 per cent depending on the way it is measured and the specific gravity of the liquid used. The average drop from the usual dropping bottle or burette measures about one minim or approximately one-twentieth of a cubic centimeter.

EASTMAN KODAK COMPANY,
ROCHESTER, NEW YORK.

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Be Sure to Use Pure Chemicals

TO get the best negatives from your films and plates—to get the best prints and enlargements from your negatives—it is imperative that the chemicals which you use be absolutely pure.

For all our films, plates and papers we furnish powders and solutions mixed in just the proper proportions and compounded from the purest chemicals, rigidly tested in our own laboratories.

But we go even further than this. For those who prefer to mix their own solutions by formulas, we have prepared a line of carefully tested standard photographic chemicals

Don't mar good films and plates and good paper with inferior chemicals.

This seal stands for the highest purity. Be sure it's on the package before purchasing



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