



KODAK PLUS-X AERECON II Film 3404

KODAK PLUS-X AERECON II Film 3404 is a panchromatic, black-and-white negative aerial film having extended red sensitivity and medium speed. This film has fine grain and relatively high contrast and is intended for medium- to high-altitude reconnaissance.

Its ESTAR Thin Base provides flexibility, moisture resistance, high tear resistance, and excellent dimensional stability. This film has a dyed-gel backing for antihalation protection and curl control and a thin, highly hardened emulsion to permit more rapid processing at elevated temperatures in modern continuous-processing machines.

This film was designed for processing in continuous-processing machines such as the KODAK VERSAMAT Film Processor, Model 11 or 1140, with KODAK VERSAMAT 885 Chemicals and KODAK VERSAMAT 641 Chemicals.

APPLICATIONS

KODAK PLUS-X AERECON II Film 3404 is intended for general use in reconnaissance aerial photography at medium to high altitudes.

BASE

2.5-mil (0.06 mm) ESTAR Thin Base with dyed-gel backing

TOTAL FILM THICKNESS

The nominal total thickness (unprocessed) of this film is **3.00 mils** (0.076 mm). This includes emulsion—0.30 mil (0.008 mm), base—2.5 mils (0.063 mm), and dyed-gel backing—0.20 mil (0.005 mm).

WEIGHT

The weight of 3404 Film (unprocessed), conditioned in equilibrium with 50 percent relative humidity, is **0.022 lbs/ft²** (0.0099 kg/ft²).

SPECTRAL SENSITIVITY

Panchromatic, with extended red sensitivity.

SAFELIGHT

Total darkness is required.

EXPOSURE

Aerial film speeds (ISO A or EAFS) should not be confused with conventional film speeds which are designed for roll and sheet films used in pictorial photography. The characteristics of aerial scenes differ markedly from those of ordinary pictorial or ground scenes because of the smaller range in subject luminances, atmospheric haze conditions, and other factors. Therefore, different film-speed parameters are used to relate aerial-scene characteristics to practical exposure recommendations. The KODAK Aerial Exposure Computer, KODAK Publication AS-10 has been published based on the aerial film speed criterion.

Nominal speed, daylight (no filter): EAFS or ISO A **200**

Other suggested aerial film speeds for processing these films in the KODAK VERSAMAT Film Processor, Models 11 or 1140, using VERSAMAT 885 Chemicals and 641 Chemicals can be found in the sensitometric data tables.

Note: The aerial film speeds given in this publication were obtained by rounding the calculated values to the nearest cube root of 2 step (equivalent to 1/3 stop).

Filters

KODAK PROFESSIONAL WRATTEN Gelatin Filter		
	No. 12	No. 25
Filter Factor	2	4

Typical Camera Exposure

A typical exposure for this film is approximately 1/500 second at f/8. This exposure is based on a solar altitude of 20 degrees, a clear day, and an aircraft altitude of 10,000 feet.

When using an aerial camera equipped with an antivignetting filter, or other filter, it is important to increase this typical exposure by the filter factor of the filter used.

Reciprocity Characteristics

No exposure or development time adjustments are required for exposure times from 1,000 second to 1/100 second. At 1/10,000 second, adjust the lens aperture by +1/2 stop and decrease the development time by 10 percent. At 1/10 second, adjust the lens aperture by +1/2 stop.

IMAGE STRUCTURE

The following data are based on processing in a KODAK VERSAMAT Film Processor using KODAK VERSAMAT Chemicals.

Resolving Power (line pairs/mm)		rms Granularity ¹
TOC 1.6:1	TOC 1000:1	
55	130	20

¹Granularity values read at a net diffuse density of 1.0 with a 48-micrometre aperture.

STORAGE

For consistent results, all aerial films should be stored under fairly constant conditions. Kodak aerial films are “usually” packaged in equilibrium with 40 to 50 percent relative humidity. High temperatures or high humidity may produce undesirable changes in the film.

Unexposed Film

Store unexposed film in a refrigerator at 55°F (13°C) or lower, or freezer at 0 to -10°F (-18 to -23°C), in the original sealed container. If the film is stored in a refrigerator, remove it about 2 hours before opening; if stored in a freezer, remove it about 8 hours before opening. A sufficient warm-up time is necessary to prevent moisture condensation on cold film -- otherwise, moisture spotting, ferrotyping, or sticking may occur.

Exposed Film

Keep exposed film cool and dry. Process the film as soon as possible after exposure to avoid undesirable changes in the latent image. If it is necessary to hold exposed but unprocessed film for several days (such as over a weekend), it should be resealed and refrigerated at 40°F (4°C) or lower. Before unsealing and processing exposed film that has been held in cold storage, follow the warm-up procedures described for unexposed film described above.

Processed Film

For best keeping, store processed film in a dark, dust-free area at 50 to 70°F (10 to 21°C) and 30 to 50 percent relative humidity. Preferably, store negatives on the spool or in individual KODAK Sleeves. High relative humidity promotes the growth of mold and causes ferrotyping. Very low relative humidity causes excessive curl and brittleness. Avoid storage temperatures over 80°F (27°C).

PROCESSING

KODAK PLUS-X AERECON II Film 3404 can be processed in the KODAK VERSAMAT Film Processor, Model 11 or 1140 with KODAK VERSAMAT 885 Chemicals or KODAK VERSAMAT 641 Chemicals.

Mechanized processing in roller-transport processors offers the advantages of uniform treatment of all portions of the roll, freedom from banding, and absence of significant density variations from ends of the roll to the center. Refer to the operator's manual for the processor set-up information, but in all cases, the fixer replenisher should be introduced into tank No. 5 of the processor with a countercurrent flow to tank No. 3, where it overflows to a collection or recovery system.

General instructions for setting the machine dryer temperature are included in these pages. However, the temperature of the dryer may require some further adjustment, depending upon the ambient temperature conditions in the processing area. Usually it is best to set the temperature approximately 3°F (2°C) above that required to dry unexposed, processed film.

Chemicals

The following KODAK VERSAMAT Chemicals may be used in both the Model 11 and Model 1140 VERSAMAT Processors.

KODAK VERSAMAT 885 Developer Starter
KODAK VERSAMAT 885 Developer Replenisher
KODAK VERSAMAT 885 Fixer and Replenisher
KODAK VERSAMAT 641 Developer Starter
KODAK VERSAMAT 641 Developer Replenisher
KODAK VERSAMAT 641 Fixer and Replenisher

Notice: Observe precautionary information on product labels and Material Safety Data Sheets.

Replenishment Rates

Basic developer and fixer replenishment rates, in millilitres per square inch of film processed, vary depending upon the type of chemicals used. The following rates apply to processing in the VERSAMAT Processor, Models 11 and 1140.

Basic Replenishment Rates (mL/in ²) KODAK VERSAMAT Chemicals		
	885	641
Developer	0.22	0.22
Fixer	0.20	0.30

Processing Sequence

KODAK VERSAMAT Processor, Model 11 (all recommended chemicals)			
Processing Step	No. of Racks	Path Length	Temperature
Develop	1 or 2	1.2 or 2.4 m (4 or 8 ft)	85 ± 0.5°F (29.5 ± 0.3°C)
Fix	3	3.6 m (12 ft)	85°F (29.5°C), nominal
Wash	2	2.4 m (8 ft)	2 to 6°F (1 to 3°C) below developer temperature
Dry	—	2.4 m (8 ft)	135 to 145°F (57 to 63°C)

Sensitometric Data

KODAK VERSAMAT 885 Chemicals, Model 11						
Machine Speed (fpm)	1 Developer Rack			2 Developer Racks		
	Average Gamma	ISO A	D-min	Average Gamma	ISO A	D-min
85°F (29.5°C)						
5	1.70	200	0.10	1.70	250	0.25
10	1.05	125	0.07	1.65	200	0.10
15	0.80	100	0.06	1.40	160	0.08
20	0.65	64	0.06	1.15	160	0.07
25	0.70	50	0.07	0.95	125	0.06

KODAK VERSAMAT 641 Chemicals, Model 11						
Machine Speed (fpm)	1 Developer Rack			2 Developer Racks		
	Average Gamma	ISO A	D-min	Average Gamma	ISO A	D-min
85°F (29.5°C)						
5	1.20	125	0.06	1.70	200	0.06
10	—	—	—	1.25	125	0.06

Processing Sequence

KODAK VERSAMAT Processor, Model 1140 (all recommended chemicals)			
Processing Step	No. of Racks	Path Length	Temperature
Develop	1 or 2	1.2 or 2.4 m (4 or 8 ft)	99 or 104 ± 0.5°F (37 or 40 ± 0.3°C)
Fix	3	3.6 m (12 ft)	99 or 104°F (37 or 40°C), nominal
Wash	2	2.4 m (8 ft)	2 to 6°F (1 to 3°C) below developer temperature
Dry	—	2.4 m (8 ft)	Up to 149°F (65°C)

Sensitometric Data

KODAK VERSAMAT 885 Chemicals, Model 1140						
Machine Speed (fpm)	1 Developer Rack			2 Developer Racks		
	Average Gamma	ISO A	D-min	Average Gamma	ISO A	D-min
99°F (37°C)						
10	1.50	200	0.10	1.65	250	0.27
20	0.90	125	0.07	1.60	200	0.11
30	0.65	80	0.06	1.15	160	0.08
40	0.55	50	0.07	0.90	125	0.07
104°F (40°C)						
10	1.60	200	0.12	—	—	—
20	0.95	160	0.08	1.70	200	0.19
30	0.75	100	0.07	1.45	200	0.13
40	0.60	80	0.08	1.10	160	0.19

Fixing: Adequate fixing is obtained at machine speeds up to and including 30 feet per minute.

Washing: LE-100 keeping quality may be obtained at all practical machine speeds. (LE = Life Expectancy)

Drying: Adequate drying is obtained at machine speeds up to and including 35 feet per minute.

KODAK VERSAMAT 641 Chemicals, Model 1140						
Machine Speed (fpm)	1 Developer Rack			2 Developer Racks		
	Average Gamma	ISO A	D-min	Average Gamma	ISO A	D-min
99°F (37°C)						
10	1.10	160	0.06	1.70	250	0.07
104°F (40°C)						
10	1.35	160	0.06	1.70	250	0.08

REWIND OR SPIRAL REEL PROCESSING

Conventional rewind equipment is not recommended for processing this film because of the physical characteristics of the ESTAR Thin Base.

DIMENSIONAL STABILITY

The dimensional stability of aerial films is of particular interest and importance in accurate mapping and in the reproduction of maps.

Dimensional stability is an all-inclusive term. In photography, it applies to size changes caused by changes in humidity and in temperature, and by processing and aging. The absence of solvent in ESTAR Base is one of the reasons why ESTAR Base films show excellent dimensional stability. The dimensional properties of ESTAR Base may vary slightly in different directions within a sheet; the differences that may exist, however, are not always between the length and width directions.

Temporary Dimensional Changes

Thermal Coefficient of Linear Expansion:	
0.001%	per degree F of change
0.0018%	per degree C of change

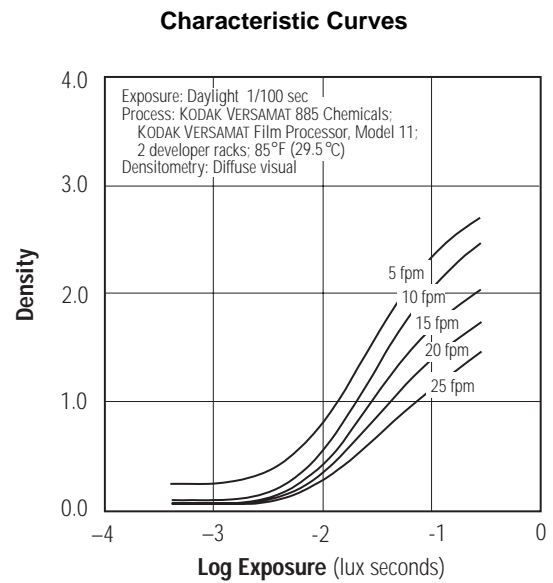
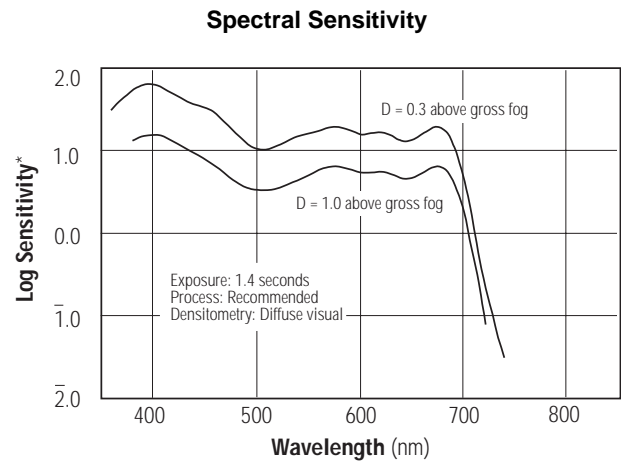
Humidity Coefficient of Linear Expansion (Unprocessed):	
0.0035%	per 1% change in relative humidity

Permanent Dimensional Changes

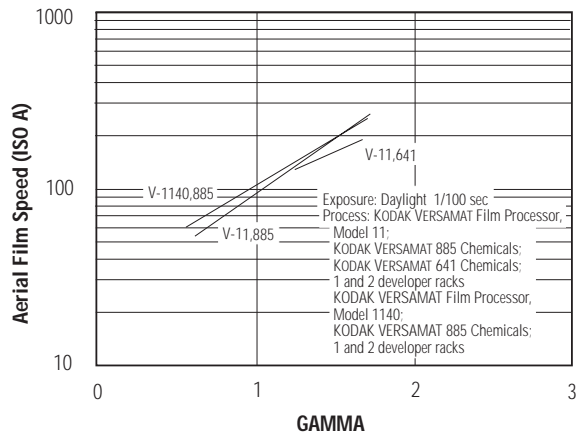
Processing Dimensional Change:	
-0.04% to +0.03%	shrinkage to swell

Aging Shrinkage of Processed Film:	
0.08%	1 week at 120°F (49°C), 20% RH
0.04%	1 year at 78°F (25.5°C), 60% RH

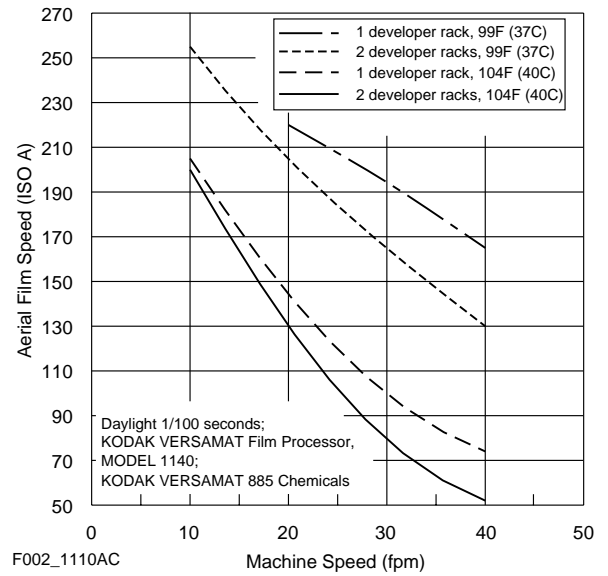
CURVES



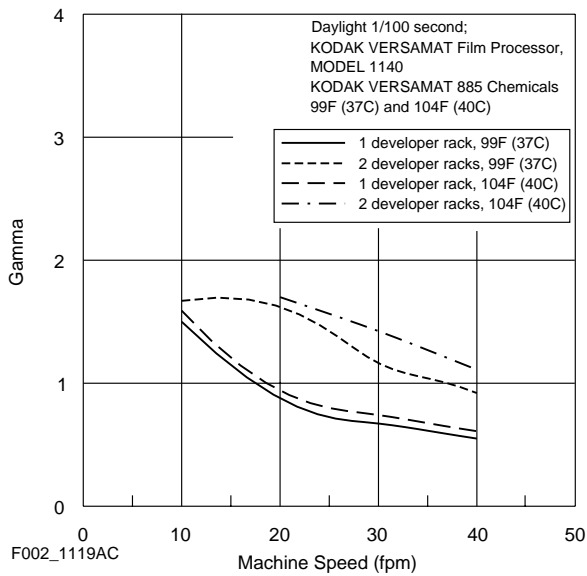
ISO A vs. Gamma



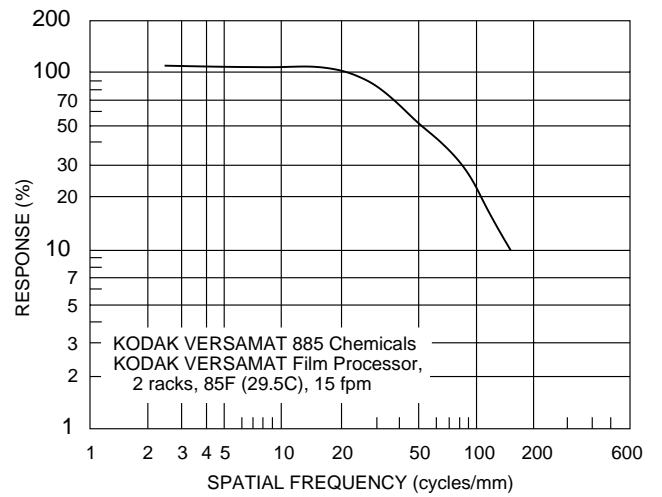
ISO A vs. Machine Speed



Gamma vs. Machine Speed



Modulation Transfer Function



KODAK PLUS-X AERECON II Film 3404

SIZE DATA AND ORDERING INFORMATION

Information on available sizes and minimum order quantities of this film is available on the web at www.kodak.com/go/aerial. You can also write or call:

Aerial Imaging
Eastman Kodak Company
343 State Street
Rochester, New York 14650-0505
(585) 724-4688
Toll-free in the US: (877) 909-4280

Note: The Kodak materials described in this publication used with KODAK PLUS-X AEROGRAPHIC Film 2402 are available from those dealers normally supplying Kodak products. Other materials may be used, but equivalent results may not be obtained.

NOTICE: While the sensitometric data in this publication are typical of production coatings, they do not represent standards which must be met by Kodak. Varying storage, exposure, and processing conditions will affect results. The company reserves the right to change and improve product characteristics at any time.

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