Aerial Data

AS-2569

KODAK AEROCHROME III MS Film 2427

KODAK AEROCHROME III MS Film 2427 is a very fine-grain, medium-speed color-reversal aerial camera film. This film has excellent color rendition and good image quality.

It has an ESTAR Base with a clear gel backing. The ESTAR Base has good optical qualities and provides flexibility, moisture resistance, high tear resistance, and excellent dimensional stability.

This film can be processed in Process AR-5 using KODAK EA-5 Chemicals in modern, continuous-processing machines such as the KODAK Aerial Color Processor, Model 1611 or the KODAK EKTACHROME RT Processor, Model 1811. It can also be processed in rewind equipment such as the Gordon/Morse rewind equipment.

APPLICATIONS

KODAK AEROCHROME III MS Film 2427 is intended for low- to medium-altitude mapping and reconnaissance applications. It provides positive color transparencies suitable for projection, direct viewing, or making color prints.

BASE

3.9-mil (0.10 mm) ESTAR Base with a clear gel backing.

TOTAL FILM THICKNESS

The nominal total thickness (unprocessed) of this film is **5.44 mils** (0.14 mm). This includes emulsion—1.04 mil (0.03 mm), base—3.9 mils (0.10 mm), and backing—0.50 mil (0.013 mm).

WEIGHT

The weight of AEROCHROME III MS Film 2427 (unprocessed), conditioned in equilibrium with 50 percent relative humidity, is **0.038 lbs/sq ft** (0.0172 kg/sq ft).

SPECTRAL SENSITIVITY

This multilayer, color-reversal film is balanced for daylight exposure.

SAFELIGHT

Total darkness is required.

EXPOSURE

Aerial Film Speeds (EAFS or ISO A equivalent) 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 luminance, atmospheric haze conditions, and other factors. Therefore, different film-speed characteristics 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 **32**
(based on development in KODAK EA-5 Chemicals)

Note: The Aerial Film Speed given in this publication is rounded to the nearest cube root of 2 step (equivalent to 1⁄3 stop).

Filters

No color-correction filters are used with this film, although a haze filter, such as a KODAK WRATTEN Filter HF-3 or No. 2B may be necessary for reducing the effects of atmospheric haze.

Typical Camera Exposure

A typical exposure for this film is approximately 1⁄500 second at f⁄4.7. This exposure is based on a solar altitude of 40 degrees, a clear day, and an aircraft altitude of 5000 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.

IMAGE STRUCTURE

The following data are based on processing in KODAK EA-5 Chemicals, Process AR-5.

Resolving Power (line pairs/mm)		rms Granularity*
TOC 1.6:1	TOC 1000:1	
80	100	13

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

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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

The primary recommendation for processing 2427 Film is in Process AR-5 using mechanized processors. 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.

Process AR-5 Cycle Times

Processor	Transport Speed (feet per minute)	Dry-to-Dry Processing Time
KODAK Aerial Color Processor, Model 1611	3.5	17.4 min
KODAK EKTACHROME RT Processor, Model 1811 (with Quick-Change)	3.5	17.2 min
KODAK EKTACHROME RT Processor, Model 1811 (Standard Configuration)	5.3	13.6 min

In each case, the film is fed *emulsion side down* into the processor.

This publication provides general information regarding the KODAK Aerial Color Processor, Mode 1611, and the KODAK EKTACHROME RT Processor, Model 1811. Refer to the operating manuals for additional set-up information.

Note: For a list of firms equipped to offer machine processing of 2427 Film, write to Eastman Kodak Company, Aerial Imaging, Rochester, New York 14653-7128.

Chemicals

Process AR-5 uses the following KODAK EA-5 Chemicals:

KODAK EA-5 First Developer *

KODAK EA-5 First Developer Replenisher

KODAK EA-5 First and Second Stop Bath and Replenisher

KODAK EA-5 Color Developer

KODAK EA-5 Color Developer Replenisher

KODAK EA-5 Bleach and Replenisher

KODAK Aerial Color Fixer and Replenisher

KODAK EA-5 Stabilizer and Replenisher

The first developer working solution is prepared by combining one part first developer with two parts first developer replenisher.

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

Processing Sequence—3.5 fpm

KODAK Aerial Color Processor, Model 1611			
Solution/ Step	**Tank No.**	**Time (Seconds)**	**Solution Temperature**
SKIP TANKS	1, 2, 3	21.3	—
First Developer	4, 5	141.6	(49.4 ± 0.3°C) 121 ± 0.5°F
First Stop	6	70.5	(46 ± 3°C) 115 ± 5°F
Wash	7	71.3	(49 ± 3°C) 120 ± 5°F
Color Developer	8, 9	140.7	(49 ± 0.6°C) 120 ± 1°F
Second Stop	10	71.1	(49 ± 3°C) 120 ± 5°F
Wash	11	70.5	(49 ± 3°C) 120 ± 5°F
Bleach	12	70.3	(49 ± 3°C) 120 ± 5°F
Fixer	13	71.3	(49 ± 3°C) 120 ± 5°F
Final Wash*	14, 15, 16	211.3	(49 ± 3°C) 120 ± 5°F
Dryer	—	106.5	(63 ± 3°C) 145 ± 5°

* Inject EA-5 Stabilizer and Replenisher into tank 16 of the final wash at a rate of 50 mL/min for all film widths.

KODAK EKTACHROME RT Processor, Model 1811, Quick-Change			
Solution/ Step	**Tank No.**	**Time (Seconds)**	**Solution Temperature**
SKIP TANKS	1 - 6	39.3	—
First Developer	7, 8	141.3	(49.4 ± 0.3°C) 121 ± 0.5°F
First Stop	9	70.3	(46 ± 3°C) 115 ± 5°F
Wash	10	71.3	(49 ± 3°C 120 ± 5°F)
Color Developer	11, 12	140.7	(49 ± 0.6°C) 120 ± 1°F
Second Stop	13	70.3	(49 ± 3°C) 120 ± 5°F
Wash	14	71.3	(49 ± 3°C) 120 ± 5°F
Bleach	15	70.5	(49 ± 3°C) 120 ± 5°F
Fixer	16	71.1	(49 ± 3°C) 120 ± 5°F
Final Wash*	17, 18	140.7	(49 ± 3°C) 120 ± 5°F
Dryer†	—	147.3	(60 ± 3°C) 140 ± 5°F

*Inject EA-5 Stabilizer and Replenisher into tank 18 of the final wash at a rate of 50 mL/min for all film widths.
†Set air damper control knobs at 8. The temperature of the dryer may require adjustment depending on the ambient temperature and humidity conditions in the processing area.

Replenishment and Wash Rates—3.5 fpm

Models 1611 and 1811 with Quick-Change*				
Solution/ Step	**Basic Rate (mL/sq ft)**	**Film Width**		
		70 mm (mL/min)	**5-in (mL/min)**	**9 1/2-in (mL/min)**
First Developer	150	120	220	415
First Stop	200	160	290	555
Wash	—2 gal/min—			
Color Developer	250	200	365	695
Second Stop	200	160	290	555
Wash	—2 gal/min (Model 1611 only)—			
Bleach	90	75	130	250
Fixer	100	80	145	275
Final Wash†	—2 gal/min—			

* These rates have been rounded to the nearest usable increment.
† Inject EA-5 Stabilizer and Replenisher into tank 16 (Model 1611) or tank 18 (Model 1811) of the final wash at a rate of 50 mL/min for all film widths. In the Model 1611, this was flows countercurrent to tanks 15 and 14. In the Model 1811, this wash overflows from tank 17 into tank 14.

Processing Sequence—5.3 fpm

KODAK EKTACHROME RT Processor, Model 1811			
Solution/ Step	**Tank No.**	**Time (Seconds)**	**Solution Temperature**
SKIP TANKS	1, 2, 3	14.6	—
First Developer	4, 5, 6	140.3	(49.4 ± 0.3°C) 121 ± 0.5°F
First Stop	7	46.9	(46 ± 3°C) 115 ± 5°F
Wash	8	46.9	(49 ± 3°C) 120 ± 5°F
Color Developer	9, 10, 11, 12	187.5	(49 ± 0.6°C) 120 ± 1°F
Second Stop	13	46.9	(49 ± 3°C) 120 ± 5°F
Wash	14	46.9	(49 ± 3°C) 120 ± 5°F
Bleach	15	46.9	(49 ± 3°C) 120 ± 5°F
Fixer	16	46.9	(49 ± 3°C) 120 ± 5°F
Wash	17	46.9	(49 ± 3°C) 120 ± 5°F
Stabilizer	18	46.9	—Equilibrium—*
Dryer (Vents set at 8)†	—	97.8	(60 ± 3°C) 140 ± 5°F

*No temperature controlling device is provided; solution temperature attains “equilibrium” depending on temperature of replenisher and surrounding conditions.
†Set air damper control knob at 8. The dryer temperature may require adjustment depending on the ambient temperature and humidity conditions in the processing area.

Replenishment and Wash Rates—5.3 fpm

Model 1811, Standard Configuration*				
Solution/ Step	Basic Rate (mL/sq ft)	Film Width		
		70 mm (mL/min)	5-in (mL/min)	9 1/2-in (mL/min)
First Developer	150	185	330	630
First Stop	200	245	440	840
Wash	—2 gal/min—			
Color Developer	250	305	550	1050
Second Stop	200	245	440	840
Bleach	90	110	200	380
Fixer	100	120	220	420
Wash†	—2 gal/min—			
Stabilizer	120	145	265	505

*These rates have been rounded to the nearest usable increment.
†This wash overflows from tank 17 into tank 14.

Bleach Regeneration

Regeneration of used EA-5 Bleach will reduce processing solution costs and substantially reduce the amount of bleach discarded to the sewer. Collection and treatment tanks for bleach overflow solution and chemical testing capability are required. A detailed laboratory procedure is available from Eastman Kodak Company.

REWIND PROCESSING

Note: This is not a primary recommendation.

KODAK AEROCHROME III MS Film 2427 yields optimum results with modern, high-temperature, continuous-processing machines. It can be processed in rewind equipment, although this method is not a primary processing recommendation. Eastman Kodak Company no longer offers packaged chemicals for such processing. Customers wishing to use rewind equipment such as the Gordon/Morse M-10 Developing Outfit (Military Designator: B-5) may contact Aerial Imaging for information on exposure, processing chemicals, process cycles, and general recommendations.

PROCESS CONTROL

KODAK Control Strips, Process AR-5, are available and are recommended for monitoring the processing of 2427 Film and several other color aerial films in KODAK roller-transport processors using EA-5 chemicals. For detailed information on process control and trouble-shooting, refer to “Using Processes AR-5 and AN-5 for KODAK Color Aerial Films,” KODAK Publication Z-200.

PRINTING TRANSPARENCIES

You can reproduce images made on AEROCHROME III MS Film by using a variety of Kodak materials.

Color Transparencies

You can make duplicates directly on KODAK PROFESSIONAL EKTACHROME Duplicating Film EDUPE. Or, you could scan your image to a file or have an internegative made, and print it on KODAK PROFESSIONAL ENDURA Clear Display Material.

Color Prints

You could scan your image to a file or have an internegative made, and print it on—

KODAK PROFESSIONAL PORTRA, SUPRA, and ULTRA ENDURA Papers

KODAK PROFESSIONAL ENDURA Transparency Display Material

KODAK PROFESSIONAL ENDURA Metallic Paper

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):	
0.0025%	per 1% change in relative humidity

Permanent Dimensional Changes

Processing Dimensional Change:	
-0.03 to +0.02%	shrinkage to swell

Aging Shrinkage of Processed Film:	
0.06%	1 week at (49°C) 120°F , 20% RH
0.03%	1 year at (25.5°C) 78°F , 60% RH

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:

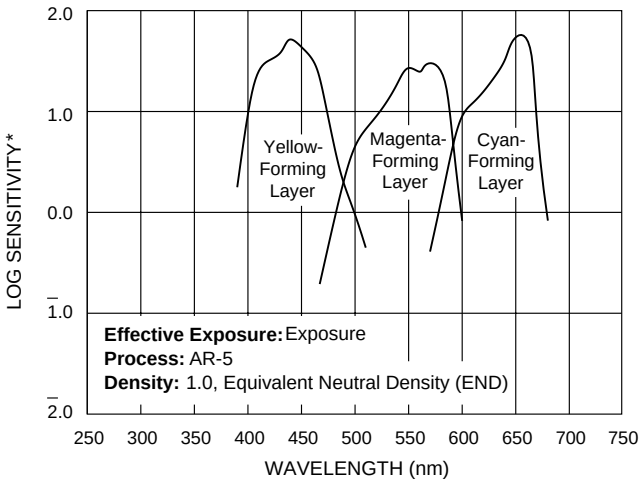
Aerial Imaging
Eastman Kodak Company
343 State Street
Rochester, New York 14650-0505
(585) 724-4688
Toll-free in the US: (877) 909-4280

Note: The Kodak materials described in this publication used with KODAK AEROCHROME III MS Film 2427 are available from those dealers normally supplying Kodak products. Other materials may be used, but equivalent results may not be obtained.

KODAK AEROCHROME III MS Film 2427

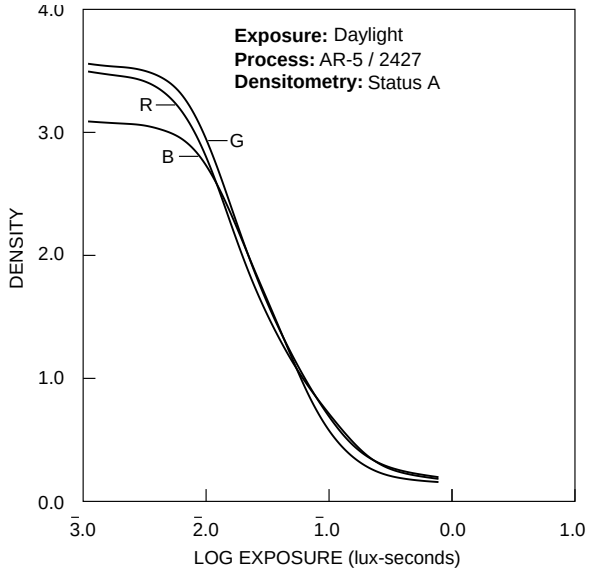
CURVES

Spectral Sensitivity

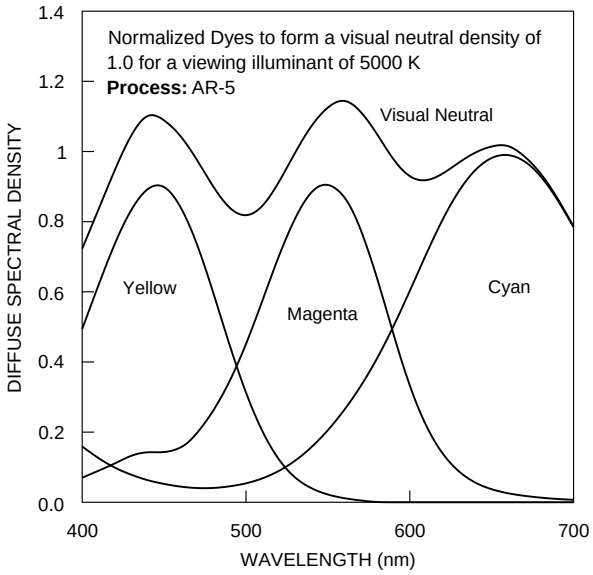


*Sensitivity = reciprocal of exposure (erg/cm^2) required to produce specified density

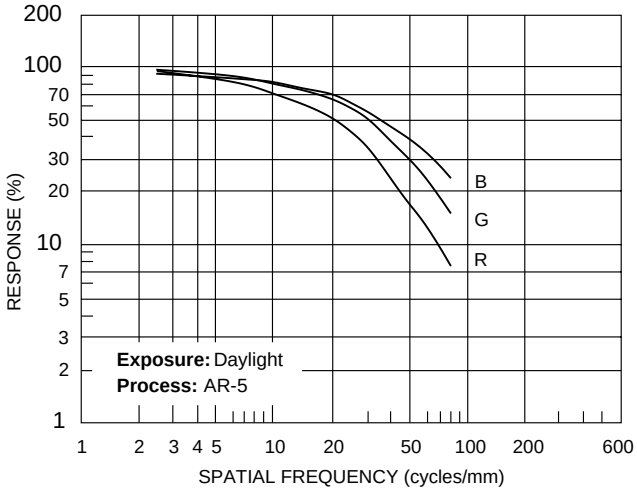
Characteristic Curves



Spectral Dye Density



Modulation Transfer Function



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 condtions will affect results. The company reserves the right to change and improve product characteristics at any time.

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