



KODAK AEROCHROME III Infrared Film 1443

KODAK AEROCHROME III Infrared Film 1443 is an infrared-sensitive, false-color reversal film intended for various aerial photographic applications where infrared discriminations may yield practical results. This film has medium resolving power and fine grain.

1443 Film has an ESTAR Base with good optical properties. The ESTAR Base 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. While not a primary recommendation, Processes AN-6 and C-41 can be used to produce a negative. Additionally, it can be processed in rewind equipment or on stainless steel reels.

COLOR FORMATION WITH COLOR INFRARED FILM

Understanding how color infrared-sensitive films are constructed* and how they develop will assist the user in a better interpretation of the final product. To understand color infrared-sensitive films, some knowledge of normal color films is necessary.

* For further information, see *Photogrammetric Engineering, October 1967, Volume 33, pages 1128 to 1138, "Optimum Methods for Using Infrared-Sensitive Color Films,"* by N.L.Fritz, Eastman Kodak Company.

Normal Color Films

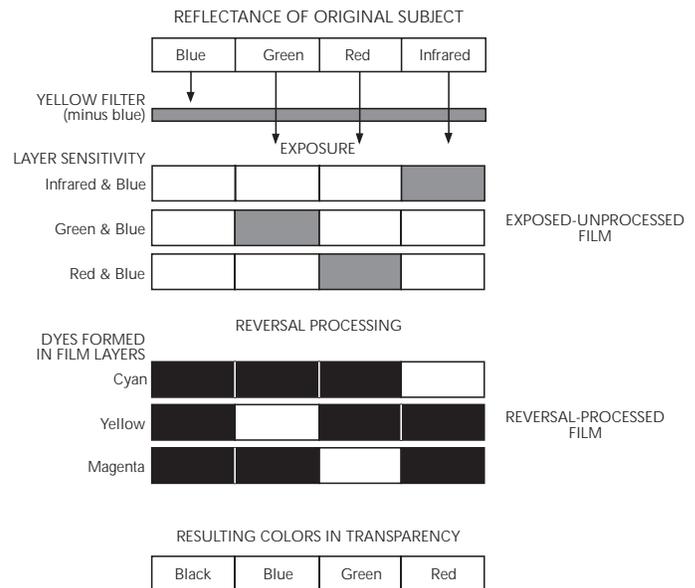
Any portion of the spectrum to which photographic materials are sensitive can be recorded in a color film if the individual emulsion layer is correspondingly sensitized. Kodak aerial color films have essentially three photo-sensitive layers. In a normal color film, such as KODAK AEROCHROME III MS Film 2427, the layers are sensitized to the three primary spectral regions—blue, green, and red. During processing, each layer produces a dye of a complementary color—yellow, magenta, and cyan, respectively. The amount of dye produced is inversely related to the intensity of the radiation from the original scene. Thus, each layer is a separate record of the brightness in a single primary color. When visible light is passed through the combinations of the three dyes, a close visual reproduction of the color in the original scene is

formed. With a negative-type color film, such as KODAK AEROCOLOR III Negative Film 2444, the colors of the combined dye images will be complementary to those in the original scene.

Color Infrared-Sensitive Films

If the color of the dye formed in a particular layer bears no relationship to the color of light to which the layer is sensitive—if the relationship is not complementary—the resulting colors are false. False-color films can be used to emphasize differences between objects that are visually quite similar. *Figure 1* demonstrates how colors are reproduced falsely on KODAK AEROCHROME III Infrared Film 1443.

Figure 1: Color Reproduction with KODAK AEROCHROME III Infrared Film 1443



As indicated in *Figure 1*, all three layers are inherently sensitive to blue radiation. To limit the exposure of each layer of color infrared film to only its intended spectral region, a yellow filter (minus blue), such as a KODAK WRATTEN Gelatin Filter No. 12, is always used over the camera lens. With the yellow filter in place, the layers act as though they are sensitive only to green, red, and infrared (all blue radiation is absorbed by the filter). The grey areas in the top portion of *Figure 1* illustrate exposed areas of silver halide from each of the spectral bands reflected from the original scene. Thus, three separate negative silver records are formed.

Where there is no exposure, reversal processing will yield cyan dye in the infrared-sensitive layer, yellow dye in the green-sensitive layer, and magenta dye in the red-sensitive layer. The amount of dye formed is inversely proportional to the exposure. The bottom portion of *Figure 1* illustrates the dye formation and resulting colors after exposure and processing. Infrared radiation appears as red, which is the result of yellow dye formation in one layer, magenta dye formation in a second layer, and the absence of cyan dye. Green reproduces as blue—the result of cyan and magenta dye formation, and the absence of yellow dye. Red reproduces as green—the result of cyan and yellow dye formation, and the absence of magenta dye.

Blue in the original subject has not been recorded because of the filter, and is therefore rendered as black. Numerous other colors will be formed, depending on the proportions of green, red, and infrared reflected or transmitted by the original subject.

APPLICATIONS

Color infrared-sensitive film (sometimes referred to as “CIR” films) is potentially one of the most useful aerial films currently available to users of aerial photography in a wide range of scientific disciplines. The advantages of color infrared-sensitive film for various applications are well documented.

AEROCHROME Infrared Film is being used or has been used in agricultural and forest surveys for the detection of crop yields, crop and tree diseases, and insect pests in forests and orchards, as well as in the identification of tree species. For example, changes in infrared reflectance have been used to detect diseased trees in citrus groves and to identify elms infested by the Dutch elm disease.

Some other applications where color infrared film is being used include: environmental studies, archaeological exploration, surface mining and mined land disturbances, hydrological studies and channel mapping, monitoring oil spills, ice reconnaissance, irrigation studies, and urban mapping where industrial haze exists (the filter reduces the atmospheric effects). It is also being used in natural resource studies, water pollution studies, instances where geographical and geological changes are in progress, the investigation of erosion along coastal areas, and for discriminating species of coastal marsh land vegetation. Color infrared films are often used in conjunction with black-and-white infrared-sensitive films, natural color films, and other films in aerial multispectral photography.

Note: A great deal of confusion exists concerning infrared photography and the measurement of infrared energy (heat waves). This confusion often leads to futile attempts to detect thermal patterns through the use of infrared photography. Contrary to what many people believe, the infrared record in a photograph is not a measure of ambient temperature variation. Thermal photography cannot be done with infrared-sensitive films because they are not thermal or heat detectors, being only sensitive to the near-infrared spectral region. (AEROCHROME Infrared Film is sensitive to approximately 900 nanometres—see the spectral sensitivity curve in this publication.) Thermal recording usually involves obtaining a visual display of longer wavelength (3 to 5 and 8 to 12 microns) radiation, such as on a cathode-ray tube, and then photographing these thermographic displays by conventional means using standard black-and-white and color films.

A four-page pamphlet, *Thermal Recording and Infrared Photography of Hot Objects*, KODAK Publication No. P-570, is available. You can obtain a copy by writing to Aerial Imaging, Eastman Kodak Company, Rochester, New York 14653-7128.

Camouflage Detection

Color infrared-sensitive films were originally designed for reconnaissance and camouflage detection. In fact, the term “CD” was once used to denote the camouflage detection role of this film. Color infrared films were sometimes effective when used to photograph objects painted to imitate foliage. Some paints may have infrared reflectance characteristics quite different than those of foliage. In the resulting color infrared transparency, the areas of healthy deciduous foliage will be magenta or red, and the painted objects may be purple or blue. (However, some paints have now been developed with spectral curves closely approximating those of some foliage.) Camouflaged areas are most easily detected by comparing a transparency made on color infrared-sensitive film with a normal color transparency of the same objects made on KODAK AEROCHROME III MS Film 2427.

Pollution Monitoring

Color infrared aerial film has been used to monitor pollution. This film does not detect thermal pollution (such as warm water entering a river from a generating station or hot gases above a smokestack) unless these temperature differences are accompanied by changes in color reflectance or transparency of the water or air. When pure, both water and air have very low infrared reflectance. Their reflectance may be greatly increased by the presence of minute quantities of dissolved or suspended materials. Surface “algae blooms” and weeds are recorded as pink swirls; vegetation protruding above the water surface is enhanced by its reddish pink color. Many dissolved chemicals also tend to show up dramatically in color infrared photographs of water bodies. Certain dust, pollens, aerosols, and gases in the air also may be readily detected as well as providing a record of their presence.

Forest Survey

Aerial photographs of foliage made with color infrared-sensitive film often shows great variations in color, even when normal color films render only small variations. Although deciduous and evergreen trees are similar visually, healthy deciduous trees have a much higher infrared reflectivity than healthy evergreens. As a result, this film records significant differences between the colors of these trees. Also, these color differences are most important in differentiating between healthy and sick specimens.

Experienced photointerpreters also take into account the size and shape of the objects as well as color differences when making interpretations. (Shape and size differences are more apparent when stereo pairs are viewed.) Generally, in spring and summer, healthy deciduous trees photograph magenta or red, and healthy evergreens photograph brownish red. Dead or dying deciduous leaves or evergreen needles usually photograph anywhere from dark red to green or even yellow. The leaves of deciduous trees, which turn red or yellow in autumn, still retain some of their infrared reflectivity for a while. Consequently, red leaves may photograph yellow, and yellow leaves may photograph white. In any given vegetation, the season, the water and mineral content of the soil, and the age and health of the vegetation may cause its infrared reflectance to vary. In fact, the first sign of a distressed tree (or plant) is often a decrease in infrared reflectance, which frequently first becomes apparent in color infrared photography.

Archaeology

Color infrared aerial photography is now being more extensively used in this science for the search and discovery of hidden archaeological sites. A change in the color pattern of vegetation detected in the shape or outline of a square, rectangle, or other geometrical pattern has been a clue that something regular and man-made may lie below the earth's surface—such as a grave site, building, fortification, or boundary wall. This difference may be easily overlooked in a normal color rendition, and the difference in spectral response might be difficult to separate in a black-and-white rendition.

Ice Reconnaissance

Color infrared film has been used to obtain data on sea-ice distribution and movement. Because of its low reflectance to infrared radiation, water appears very dark and the ice appears light in an image and, therefore, the interface between water and ice and land becomes very discernible.

BASE

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

TOTAL FILM THICKNESS

The nominal total thickness (unprocessed) of 1443 Film is **5.11 mils** (0.129 mm). This includes emulsion—0.90 mil (0.02 mm), base—3.9 mils (0.10 mm), and backing—0.31 mil (0.008 mm).

WEIGHT

The weight of 1443 Film (unprocessed), conditioned in equilibrium with 50 percent relative humidity, is **0.0386 lbs/ft²** (0.0175 kg/ft²).

SPECTRAL SENSITIVITY

KODAK AEROCROME III Infrared Film 1443 is sensitive to ultraviolet, visible, and infrared radiation to approximately 900 nm.

SAFELIGHT

Total darkness is required for all handling operations such as loading and unloading of camera magazines, and during processing. The base of this film is subject to light piping.

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.

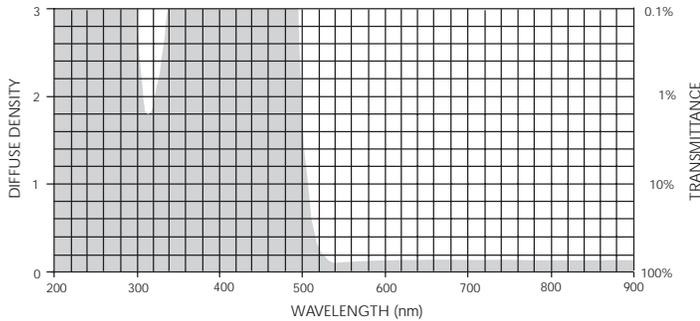
Nominal speed, daylight: EAFS or ISO A 40
(Based on exposure through a KODAK WRATTEN Filter No. 12 [deep yellow] and processing in KODAK EA-5 Chemicals, Process AR-5)

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

A KODAK WRATTEN Filter No. 12 (or equivalent) is required over the camera lens to prevent blue radiation from exposing the inherent blue sensitivities of all three emulsion layers. The spectrophotometric absorption curve for the KODAK WRATTEN Filter No. 12 is shown in Figure 2.

Figure 2: Spectral Transmission of KODAK WRATTEN Filter No. 12



Typical Camera Exposure

A typical exposure for this film is approximately 1/300 second at $f/5.6$ with a KODAK WRATTEN Filter No. 12. This exposure is based on a solar altitude of 40 degrees, a clear day, and an aircraft altitude of 10,000 feet.

Note: If rewind processing or stainless steel reel processing is to be used for processing this film, a filter change for exposing the film is required.

Reciprocity Characteristics

No filter or exposure adjustment is required for exposure times from 1/1,000 second to 1/100 second.

“Flight-Line Syndrome”

KODAK AEROCHROME Infrared Film can be adversely affected by certain environmental conditions, particularly low humidity. This dryness can affect the portion of film which dwells on the platen between flight lines or between long exposure cycle times, resulting in a color balance shift. A common practice used to compensate for this effect is to cycle the camera for two frames just before the actual start of the flight line so that all frames are at the same common moisture equilibrium.

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	
63	100	23

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

STORAGE

Color films, particularly false-color films such as AEROCHROME III Infrared Film 1443, are usually more seriously affected by adverse storage conditions than normal color or black-and-white films. Color infrared film is extremely sensitive to variations in temperature and relative humidity. Storage conditions affect the three image-forming layers in different degrees, causing a change in color balance as well as a change in overall film speed and contrast. In the case of AEROCHROME Infrared Film, the infrared-sensitive layer is most affected, causing a loss in infrared sensitivity and a resultant color balance drift toward cyan.

Unexposed Film

The keeping characteristics of unexposed color infrared film is such that they must be kept in a freezer or refrigerator. It is possible to store the unexposed film up to 14 days at temperatures not exceeding 35°F (2°C). Best infrared sensitivity is maintained by storing this film at 0 to -10°F (-18 to -23°C), in their original sealed container. If properly stored at 0°F (-18°C), this film should be removed to room temperature at least 8 hours before opening the container to prevent condensation of atmospheric moisture on the cold film—otherwise, spotting ferrotyping or sticking may occur. The precise time required for warm-up depends on film width, roll length, storage, and ambient conditions.

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 KODAK AEROCHROME III Infrared 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	5.4	11.3 min
KODAK EKTACHROME RT Processor, Model 1811 (with Quick-Change)	5.4	11.1 min
KODAK EKTACHROME RT Processor, Model 1811 (Standard Configuration)	9.0	8 min

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

This publication provides general information regarding the KODAK Aerial Color Processor, Model 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 1443 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.

AR-5 Processing Sequence—5.4 fpm

KODAK Aerial Color Processor, Model 1611

Solution/Step	Tank No.	Time (Seconds)	Solution Temperature	
			°F	°C
SKIP TANKS	1, 2, 3	14.0	—	—
First Developer	4, 5	91.6	119 ± 0.5	48.3 ± 0.3
First Stop	6	45.8	115 ± 5	46 ± 3
Wash	7	45.8	120 ± 5	49 ± 3
Color Developer	8, 9	91.6	120 ± 1	49 ± 0.6
Second Stop	10	45.8	120 ± 5	49 ± 3
Wash	11	45.8	120 ± 5	49 ± 3
Bleach	12	45.8	120 ± 5	49 ± 3
Fixer	13	45.8	115 ± 5	46 ± 3
Final Wash*	14, 15, 16	136.9	120 ± 5	49 ± 3
Dryer	—	69.0	145 ± 5	63 ± 3

* 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	
			°F	°C
SKIP TANKS	1 - 6	25.4	—	—
First Developer	7, 8	91.6	119 ± 0.5	48.3 ± 0.3
First Stop	9	45.8	115 ± 5	46 ± 3
Wash	10	45.8	120 ± 5	49 ± 3
Color Developer	11, 12	91.6	120 ± 1	49 ± 0.6
Second Stop	13	45.8	120 ± 5	49 ± 3
Wash	14	45.8	120 ± 5	49 ± 3
Bleach	15	45.8	120 ± 5	49 ± 3
Fixer	16	45.8	115 ± 5	46 ± 3
Final Wash*	17, 18	91.6	120 ± 5	49 ± 3
Dryer†	—	95.1	140 ± 5	60 ± 3

* 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.

AR-5 Replenishment and Wash Rates— 5.4 fpm

Models 1611 and 1811 with Quick-Change*				
Solution/Step	Basic Rate (mL/ft ²)	Film Width		
		70 mm (mL/min)	5-in (mL/min)	9 1/2-in (mL/min)
First Developer	175	220	400	750
First Stop	200	250	450	855
Wash	2 gal/min			
Color Developer	250	310	565	1070
Second Stop	200	250	450	855
Wash	2 gal/min (Model 1611 only)			
Bleach	90	115	205	385
Fixer	100	125	225	430
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 wash flows countercurrent to tanks 15 and 14. In the Model 1811, this wash overflows from tank 17 into tank 14.

AR-5 Processing Sequence—9 fpm

KODAK EKTACHROME RT Processor, Model 1811, Quick-Change

Solution/Step	Tank No.	Time (Seconds)	Solution Temperature	
			°F	°C
SKIP TANKS	1, 2, 3	11.5	—	—
First Developer	4, 5, 6	82.8	119 ± 0.5	48.3 ± 0.3
First Stop	7	27.6	115 ± 5	46 ± 3
Wash	8	27.6	120 ± 5	49 ± 3
Color Developer	9, 10, 11, 12	110.4	120 ± 1	49 ± 0.6
Second Stop	13	27.6	120 ± 5	49 ± 3
Wash	14	27.6	120 ± 5	49 ± 3
Bleach	15	27.6	120 ± 5	49 ± 3
Fixer	16	27.6	120 ± 5	49 ± 3
Wash	17	27.6	120 ± 5	49 ± 3
Stabilizer	18	27.6	—Equilibrium*—	
Dryer†	—	54.7	140 ± 5	60 ± 3

* 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.

AR-5 Replenishment and Wash Rates—9 fpm

Model 1811, Standard Configuration*				
Solution/Step	Basic Rate (mL/ft ²)	Film Width		
		70 mm (mL/min)	5-in (mL/min)	9 1/2-in (mL/min)
First Developer	175	365	655	1250
First Stop	200	415	750	1425
Wash	2 gal/min			
Color Developer	250	520	940	1780
Second Stop	200	415	750	1425
Bleach	90	190	340	640
Fixer	100	210	375	710
Wash†	2 gal/min			
Stabilizer	120	250	450	855

* 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.

NEGATIVE PROCESSING

Note: This is not a primary recommendation.

While the primary recommendation for processing AEROCHROME III Infrared Film is in Process AR-5, it may also be processed to produce a negative image in Process AN-6 or in FLEXICOLOR Chemicals for Process C-41, with appropriate developer temperature adjustments. Careful attention must be paid to developer time and temperature to avoid undesirable chemical fog.

The following AN-6 and C-41 recommendations will yield similar results. In either case, photographic speed will be slower than that of standard reversal processing (ISO A 32 vs. 40), so a corresponding exposure adjustment of +1/3 stop is required when processing to a negative is desired.

Process AN-6 Cycle Times

Processor	Transport Speed (feet per minute)	Dry-to-Dry Processing Time
KODAK Aerial Color Processor, Model 1611	4.2	11.8 minutes
KODAK EKTACHROME RT Processor, Model 1811 (with Quick-Change)	4.2	11.6 minutes

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

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

Chemicals

Process AN-6 uses the following KODAK EA-5 and AN-6 Chemicals:

- KODAK Developer Starter, Process AN-6
- KODAK Developer Replenisher, Process AN-6
- KODAK EA-5 First and Second Stop Bath and Replenisher
- KODAK EA-5 Bleach and Replenisher
- KODAK Aerial Color Fixer and Replenisher
- KODAK EA-5 Stabilizer and Replenisher

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

AN-6 Processing Sequence—4.2 fpm

KODAK Aerial Color Processor, Model 1611

Solution/Step	Tank No.	Time (seconds)	Temperature	
			°F	°C
AN-6 Developer	1, 2, 3	179.3	90 ± 0.5	32.2 ± 0.3
Skip Tanks	4 - 9	28.4	—	—
Stop Bath	10	58.9	120 ± 5	49 ± 3
Wash	11	58.9	120 ± 5	49 ± 3
Bleach	12	58.9	120 ± 5	49 ± 3
Fixer	13	58.9	115 ± 5	46 ± 3
Final Wash*	14, 15, 16	176.0	120 ± 5	49 ± 3
Dryer	—	88.7	145 ± 5	63 ± 3

* 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)	Temperature	
			°F	°C
Skip Tanks	1, 2, 3	18.1	—	—
AN-6 Developer	4, 5, 6	175.9	90 ± 0.5	32.2 ± 0.3
Skip Tanks	7 - 12	29.2	—	—
Second Stop	13	58.6	120 ± 5	49 ± 3
Wash	14	58.6	120 ± 5	49 ± 3
Bleach	15	58.6	120 ± 5	49 ± 3
Fixer	16	58.6	115 ± 5	46 ± 3
Final Wash*	17, 18	117.3	120 ± 5	49 ± 3
Dryer†	—	122.1	140 ± 5	60 ± 3

* 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 dryer temperature may require adjustment depending on the ambient temperature and humidity conditions in the processing area.

AN-6 Replenishment and Wash Rates—4.2 fpm

Note: These rates have been rounded to the nearest usable increment.

Models 1611 and 1811 with Quick Change

Solution/Step	Basic Rate (mL/ft ²)	Film Width		
		70 mm (mL/min)	5-in. (mL/min)	9 1/2-in. (mL/min)
AN-6 Developer*	100	100	175	335
Stop Bath	200	195	350	665
Wash	— 2 gal/min —			
Bleach	90	90	160	300
Fixer	100	100	175	335
Final Wash†	— 2 gal/min —			

* The required rates will vary with the average exposure level. Make an adjustment if the control strip density levels increase or decrease substantially.

† 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 wash flows countercurrent to tanks 15 and 14. In the Model 1811, this wash flows countercurrent to tank 17.

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.

C-41 Processing

This film may be processed in KODAK FLEXICOLOR Chemicals for Process C-41. To achieve results like Process AN-6, use a development time of 3'45" at 92°F (33.3°C) with a basic replenishment rate of 105 mL/ft². Substitute AN-6 Developer using a developer time of 3'00" at 90°F (32.2°C) for increased productivity.

Note: Do not use KODAK FLEXICOLOR Developer LORR, as the low tank turnover would be insufficient to maintain proper chemical equilibrium and sensitometric control.

Process C-41

FLEXICOLOR Chemical	Time min:sec (sec)	Temp °C (°F)	Basic Repl Rate (mL/ft ²)
Developer	3:45 (225)	33.3 ± 0.3 (92 ± 0.5)*	105
Bleach III NR	3:00 to 6:00 (180 to 360)	38 ± 3 (100 ± 5)*	95
Wash	1:05 (65)	24 to 41 (75 to 105)†	2900‡
Fixer§	1:00 to 4:00 (60 to 240)	38 ± 3 (100 ± 5)	95
Wash	3:15 (195)¶	24 to 41 (75 to 105)	2900‡
Stabilizer III	1:05 (65)	24 to 41 (75 to 105)	95
Dry	As needed	Not over 60 (140)	

* If you increase the bleach and fixer times to 6:30 or longer, you can extend the temperature range to 75 to 105°F (24 to 41°C).

† In some processors, a lower wash-water temperature may affect solution temperatures in adjacent tanks. Longer warm-up times may be needed. If it affects developer temperature during processing, you may need to use a higher wash-water temperature.

‡ Rates are for first wash and a two-stage countercurrent final wash. Double these rates for a single-stage final wash.

§ Use a two-stage (two-tank) countercurrent fixer, preferably with the same time in each tank. Agitation and filtration in each tank are required. If your processor has a single fixer tank, using in-line electrolytic desilvering will decrease the safety factor for adequate fixing.

¶ If your squeegees are efficient enough to maintain a low fixer carryover, you can reduce the wash time to 2:10.

For additional information in using Process C-41, see KODAK Publication Z-131, *Process C-41 using KODAK FLEXICOLOR Chemicals*.

REWIND PROCESSING

Note: This is not a primary recommendation.

KODAK AEROCHROME III Infrared Film 1443 yields optimum results with modern, high-temperature, continuous-processing machines. It can be processed in rewind equipment or on spiral reels, although these methods are not a primary processing recommendation. A change in camera filtration may be necessary during exposure to offset the different color balance produced by this processing method. 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

Process fluctuations should be kept to a minimum. Follow the recommended procedures and include process control strips at regular intervals. KODAK Control Strips, Process AR-5, are available and are recommended for monitoring the processing of AEROCHROME III Infrared 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 Infrared Film by using a variety of Kodak materials.

Color Transparencies

For 1443 Film transparencies (Process AR-5), 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.

If you have 1443 Film negatives (Process C-41), you can make transparencies directly (or by first scanning) on KODAK PROFESSIONAL ENDURA Clear Display Material.

Color Prints

For 1443 Film transparencies (Process AR-5), you could scan your image to a file or have an internegative made, and print it on the materials listed below.

If you have 1443 Film negatives (Process C-41), you can make prints directly (or by first scanning) 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 120°F (49°C), 20% RH
0.03%	1 year at 78°F (25.5°C), 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:

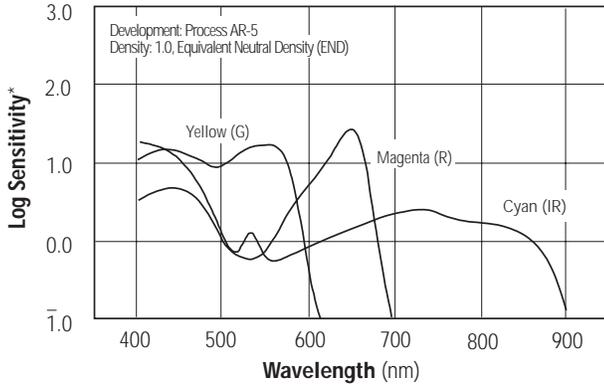
Aerial Imaging
Eastman Kodak Company
343 State Street
Rochester, New York 14650-0505
(585) 724-4688
Toll-free in the US: (877) 909-4280

Note: The Kodak materials described in this publication used with KODAK AEROCHROME III Infrared Film 1443 are available from those dealers normally supplying Kodak products. Other materials may be used, but equivalent results may not be obtained.

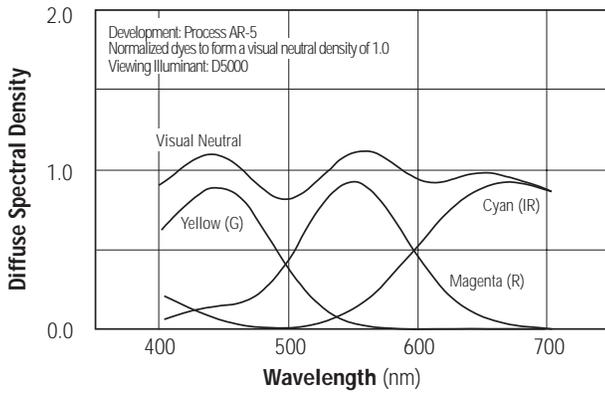
KODAK AEROCHROME III Infrared Film 1443

CURVES

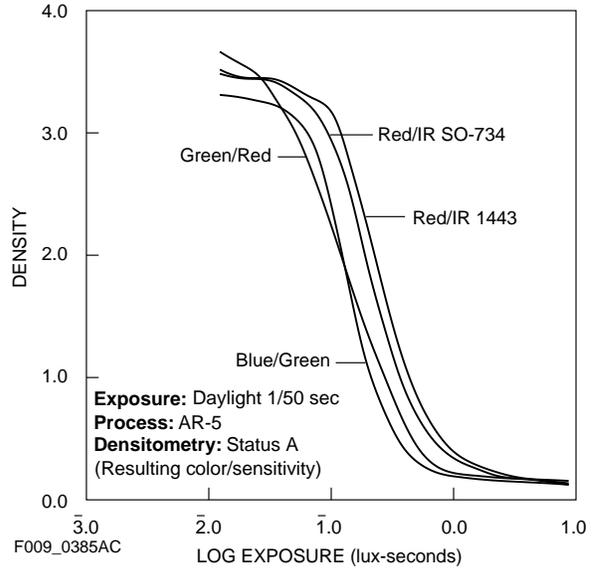
Spectral Sensitivity



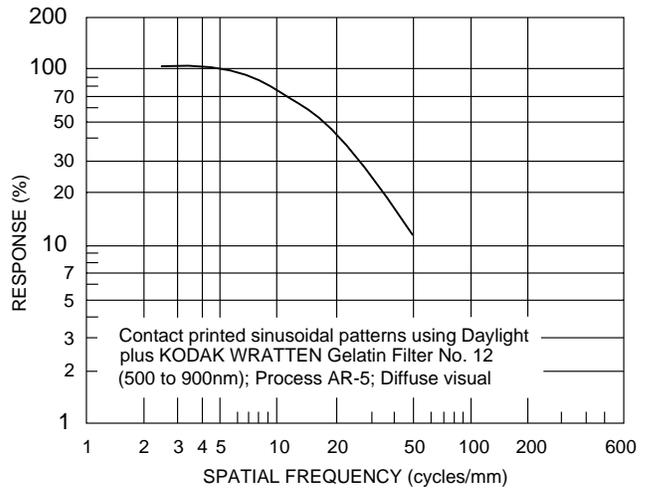
Spectral Dye Density (preliminary data)



Characteristic Curves



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

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