



KODAK High Resolution Aerial Duplicating Film SO-192 KODAK High Resolution Aerial Duplicating Film SO-187

These black-and-white negative aerial duplicating films consist of blue-sensitive, micro-fine grain and ultra-high resolving power, hardened emulsions that are coated on either a 4-mil ESTAR Base or a 7-mil ESTAR Thick Base with a fast-drying backing. The photographic properties of these two films are virtually identical; the physical properties differ due to the differences in base thickness.

The ESTAR Base provides flexibility, moisture resistance, high tear resistance, and excellent dimensional stability.

These films can be processed in modern continuous-process machines such as the KODAK VERSAMAT Film Processor, Model 11 or 1140, with KODAK VERSAMAT 885 Chemicals or KODAK VERSAMAT 641 Chemicals. Only data for KODAK VERSAMAT 885 Chemicals are shown in this data publication. In addition, these films can also be tray-processed in such common developers as KODAK Developer D-19 or KODAK Developer DK-50.

APPLICATIONS

These films are designed for duplicating very fine grain, high definition aerial negatives. They are intended for use as a second generation positive and a third generation negative.

Note: In some photogrammetric applications, SO-187 Film in sheet form may have sufficient dimensional stability to meet requirements for use as aerial diapositives in place of glass plates. A 7-mil ESTAR Thick Base provides the best dimensional stability available in a Kodak flexible film support. It is suggested that SO-187 Film be tested to determine if it meets your photogrammetric requirements.

BASE

SO-192 Film: 3.9-mil (0.10 mm) ESTAR Base with a fast-drying backing

SO-187 Film: 7-mil (0.18 mm) ESTAR Thick Base with a fast-drying backing

TOTAL FILM THICKNESS

The nominal total thickness (unprocessed) of each film is:

SO-192 Film: 4.16 mils (0.106 mm)

This includes emulsion—0.26 mils (0.006 mm), base—3.9 mils (0.10 mm) and backing—nil.

SO-187 Film: 7.26 mils (0.184 mm)

This includes emulsion—0.26 mils (0.006 mm), base—7.0 mils (0.178 mm) and backing—nil.

WEIGHT

The weight of each film (unprocessed), conditioned in equilibrium with 50 percent relative humidity, is:

SO-192 Film: 0.032 lbs/ft² (0.014 kg/ft²)

SO-187 Film: 0.054 lbs/sq ft² (0.024 kg/ft²)

SPECTRAL SENSITIVITY

Blue sensitive.

SAFELIGHT

Use a KODAK 1 Safelight Filter (red) in a suitable safelight lamp with a 15-watt bulb at not less than 4 feet (1.2 metres) from the film.

IMAGE STRUCTURE

The following values are based on processing in a KODAK VERSAMAT Film Processor, Model 11, using KODAK VERSAMAT 885 Chemicals (1 rack, 20 fpm, 85°F (29.5°C), process gamma 2.10).

Resolving Power (line pairs/mm)		rms Granularity*
TOC 1.6:1	TOC 1000:1	
250	800	5

* Granularity 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).

EXPOSURE

These films may be exposed using a variety of printing sources. As in most projection or contact printing operations, the optimum exposure level required for a given processing condition is determined by test exposures.

Reciprocity Characteristics:

Reciprocity data for projection-speed and contact-speed duplicating films are useful when using an on-easel photometer for exposure determination.

No exposure or development time adjustments are required for exposure times from 1/1,000 second to 1/100 second. At 1/10 second, decrease the neutral density filters -0.15. At 1 second, decrease the neutral density filters -0.30 or adjust the exposure time to 2 seconds.

PROCESSING

KODAK High Resolution Aerial Duplicating Film SO-192 and KODAK High Resolution Aerial Duplicating Film SO-187 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 Film 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 when using KODAK VERSAMAT 885 Chemicals.

Developer	0.08 mL/in ²
Fixer	0.15 mL/in ²

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 85°F (29.5°C), Model 11				
Machine Speed (fpm)	1 Developer Rack		2 Developer Racks	
	Average Gamma	D-min	Average Gamma	D-min
5	2.00	0.08	2.00	0.18
10	2.20	0.05	2.10	0.28
15	2.20	0.04	2.10	0.06
20	2.10	0.04	2.10	0.05
25	1.90	0.04	2.10	0.05

Fixing: Adequate fixing is obtained at machine speeds up to and including 25 feet per minute.

Washing: LE-500 keeping quality is obtained at machine speeds up to and including 5 feet per minute with 1 developer rack. LE-100 may be obtained at all other practical machine processing speeds with 1 or 2 racks. (LE = Life Expectancy)

Drying: Adequate drying is obtained at machine speeds up to and including 25 feet per minute.

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)	104 ± 0.5°F (40 ± 0.3°C)
Fix	3	3.6 m (12 ft)	104°F (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, 104°F (40°C), Model 1140				
Machine Speed (fpm)	1 Developer Rack		2 Developer Racks	
	Average Gamma	D-min	Average Gamma	D-min
10	1.80	0.20	—	—
20	2.00	0.06	1.70	0.24
30	2.00	0.05	1.80	0.13
40	2.00	0.04	2.00	0.10

Fixing: Adequate fixing is obtained at machine speeds up to and including 40 feet per minute.

Washing: LE-500 keeping quality is obtained at machine speeds up to and including 20 feet per minute with 1 developer rack. LE-100 may be obtained at all other practical machine processing speeds with 1 or 2 racks. (LE = Life Expectancy)

Drying: Adequate drying is obtained at machine speeds up to and including 40 feet per minute.

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:		
SO-192	SO-187	
0.001%	0.001%	per degree F of change
0.0018%	0.0018%	per degree C of change

Humidity Coefficient of Linear Expansion (Unprocessed):		
SO-192	SO-187	
0.0018%	0.0015%	per 1% change in relative humidity

Permanent Dimensional Changes

Processing Dimensional Change (percent shrinkage to swell):	
2430	SO-243
-0.02% to +0.02%	-0.01% to +0.02%

Aging Shrinkage of Processed Film:		
SO-192	SO-187	
0.02%	0.02%	1 week at 120°F (49°C), 20% RH
0.02%	0.02%	1 year at 78°F (25.5°C), 60% RH

SIZE DATA AND ORDERING INFORMATION

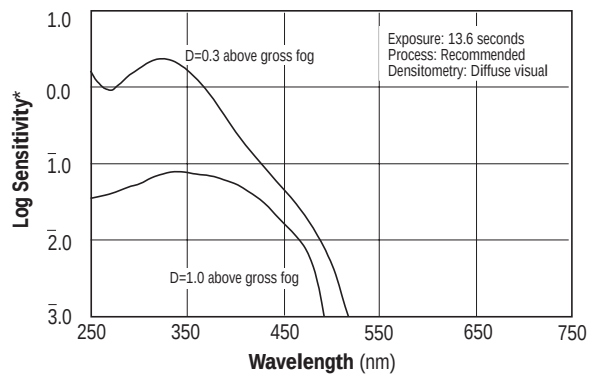
Information on available sizes and minimum order quantities of this film is available on the web at **www.kodak.com/go/aerial**. You can also write or call:

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

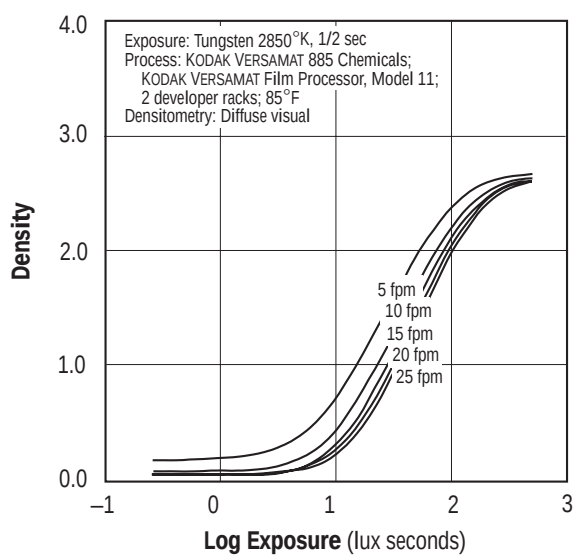
Note: The Kodak materials described in this publication used with KODAK High Resolution Aerial Duplicating Films SO-192 and SO-187 are available from those dealers normally supplying Kodak products. Other materials may be used, but equivalent results may not be obtained.

CURVES

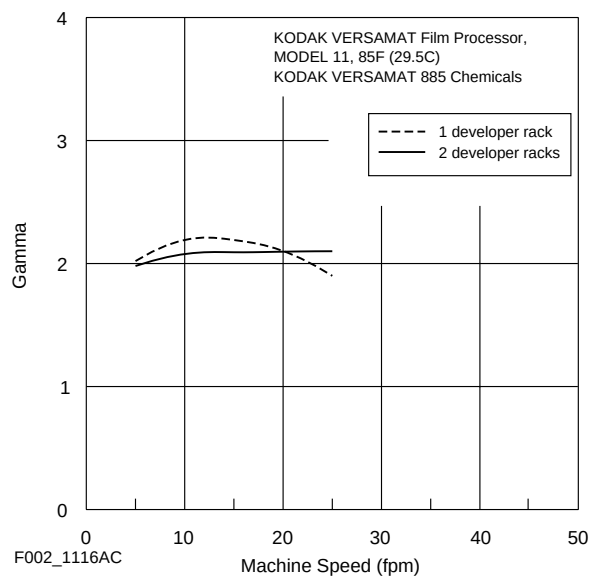
Spectral Sensitivity



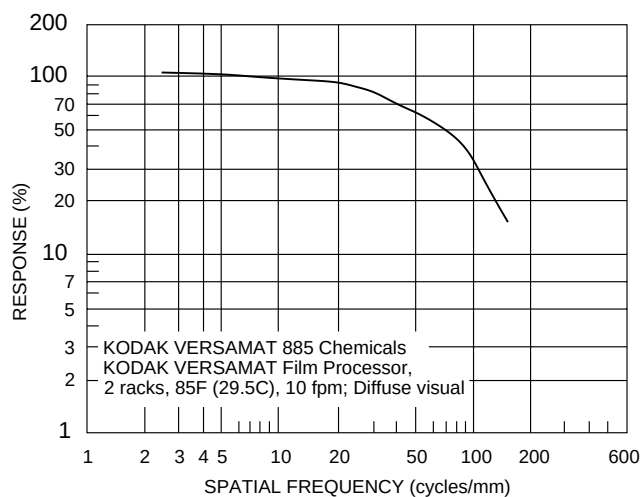
Characteristic



Gamma vs. Machine Speed



Modulation Transfer Function



F002_1097AC

KODAK High Resolution Aerial Duplicating Film SO-192

KODAK High Resolution Aerial Duplicating Film SO-187

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.

Aerial Imaging
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