

TECHNICAL DATA / BLACK-AND-WHITE PRINT FILM

August 2022 H-1-2302

KODAK Black-and-White Print Film 2302 / 3302 / ESTAR Base is a low speed, high-resolution print film. This blue-sensitive black-and-white film is designed for general release printing. It is also useful for making both positive and negative titles. This film is coated on a proprietary ESTAR base which offers improved physical performance throughout the entire motion picture system.

BENEFITS FOR LABS	BENEFITS FOR DISTRIBUTORS/ EXHIBITORS
<ul style="list-style-type: none">• Polyester base—greater tear strength, durability, dimensional stability, and archival keeping.• Process surviving anti-static layer—protection from static marks prior to printing.• Process surviving anti-static layer—reduced dirt attraction to processed prints and static protection prior to processing.• Process surviving lubricant—better transport characteristics for processed film.• Patented antihalation dye technology—superior halation protection (no fringes in titles).	<ul style="list-style-type: none">• Polyester base, process surviving anti-static layer, scratch resistant backing layer, and process surviving lubricant—cleaner, more durable prints.• Patented anti-halation dye technology—no fringes in titles and sharper projected image.• Improved transport throughout the entire system.• Polyester base for archival keeping.

BASE

KODAK Black-and-White Print Film 2302 / 3302 is coated on thin 0.0047-inch (120 micrometers) ESTAR (polyethylene terephthalate) base, featuring a proprietary electrically conductive anti-static layer, a scratch resistant backing layer, and a process surviving backside lubricant which remains with the film after processing, eliminating the electrostatic attraction of dirt particles to the processed print even at very low relative humidity. A polymeric backing layer coated on top of the anti-static layer provides improved resistance to backside scratches, cinch marks, and abrasion of both raw stock and processed film. The backing layer also contains a process surviving lubricant and matte to optimize winding and transport characteristics.

DARKROOM RECOMMENDATIONS

Use a KODAK OC Safelight Filter / green yellow, with a 15-watt bulb, no closer to the film than 1.2 meters (4 feet).

STORAGE

Film is perishable and changes with prolonged storage or adverse storage conditions. After packaging, Kodak stores print film raw stock at 13°C (55°F) or lower. Transportation and distribution warehousing are refrigerated. Print film is not adversely affected by short-term storage at room temperatures (less than 25°C/77°F). For extended-term storage, store at -18°C (0°F) or lower. Avoid unconditioned storage, as sensitometric and physical changes occur more rapidly at high temperatures and may degrade film quality. If refrigerated storage is used, allow the sealed can or foil bag to equilibrate to room temperature before opening to avoid moisture condensation. Unused raw stock should be rebagged and put into sealed film cans before being put back in refrigerated storage. Process exposed film promptly. Store processed film according to the recommendations in ISO 18911:2010, Imaging Materials - Processed Safety Photographic Films - Storage Practices.

PRINTER CONDITIONS

Negative film of average density will produce satisfactory prints if run on a continuous additive printer (such as the Bell & Howell Model C) run at 180 ft/min., equipped with a 1200-watt lamp operated at 85 volts and a 1.0 neutral density filter in the beam for 35 mm. Typical starting-point printer settings are as follows:

BEAM	TRIM SETTING	TAPE SETTING
RED	17	21
GREEN	17	21
BLUE	17	21

PROCESSING CONDITIONS

KODAK Black-and-White Print Film 2302 / 3302 may be processed along with other D97 processed black-and-white films using Kodak recommended D97 Process. No change in process sequence is required. Complete process specifications, formulae, and procedures are contained in [KODAK Publication No. H-24-15, "Manual for Processing KODAK Motion Picture Films, Module 15"](#). The processing times may require modification depending upon the process.

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

PROCESSING STEP	TEMPERATURE	TIME	REPLENISHMENT RATE (mL per 100 ft)
			35 mm
KODAK Developer D-97 ^[1]	70°F (21°C)	--[2]	650 (D-97R)
Stop Rinse ^[3]	70°F (21°C)	50 sec	12,000
KODAK Fixing Bath F-5 ^[1]	70°F (21°C)	9 min	600
Wash (counter-current)	70°F (21°C)	10 min	12,000
Dry	95°F (35°C)	--[4]	

[1] Agitation in the developer and fixing bath should be by recirculation through submerged spray jets that impinge on the film strands.

[2] Develop to recommended control gamma of 2.4 to 2.6 (Status A). Calculation to obtain control gamma is D-min + 0.95 density to + 0.50 log E.

[3] Countercurrent flow of fixer-laden water overflow from the wash tank, pH about 6.

[4] Many factors affect the drying: air temperature, relative humidity (RH); volume, rate, and distribution of the airflow; final squeegeeing, etc. In a conventional convection-type drying cabinet with air at about 95°F (35°C) and 40 to 50 percent RH, drying will take 15 to 20 minutes. With an impingement type drying cabinet (with a higher temperature and lower RH), drying time is greatly reduced. With either type of dryer, the film should be dry without tackiness 1/2 to 2/3 of the way through. Upon cooling to room temperature after leaving the dryer, the film should be in equilibrium with the room air at approximately 50 percent RH.

SOUNDTRACK PRINTING

ANALOG—A variable-area positive silver soundtrack can be printed on 2302/3302 Film from a negative sound record on KODAK Panchromatic Sound Recording Film 2374, or EASTMAN EXR Sound Recording Film 2378. The optimum variable-area soundtrack density for the print lies between 1.0 and 1.8 measured visually. This print density is chosen to provide a good compromise between signal to noise ratio and frequency response. The densities of the sound-track negatives required to produce optimal print densities are determined by using recognized cross-modulation test procedures.

DIGITAL (e.g., Dolby Digital and SONY SDDS)—Each system vendor provides exposure recommendations and control procedures for optimum performance.

Kodak digital optimization tests for Dolby Digital indicate that the print density should fall between 1.0 and 1.7. Kodak digital optimization tests for SONY SDDS indicate that the print density should fall between 0.5 and 2.0.

NOTE: Edgecode print on standard 2302 and 3302 will interfere with SDDS tracks.

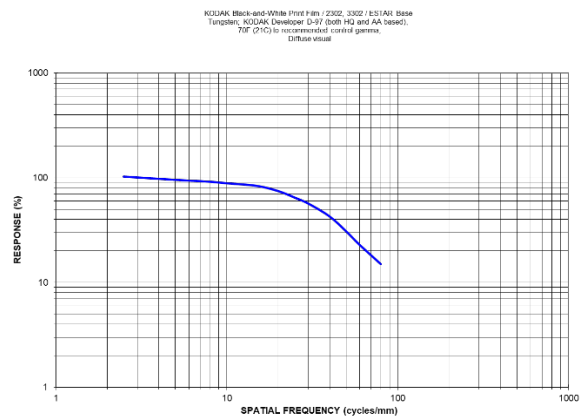
STORAGE OF PROCESSED PRINTS

KODAK Black-and-White Print Film 2302 / 3302 has excellent image stability characteristics. Store processed film according to the recommendations in ANSI/PIMA IT9.11-1998: for medium-term storage (minimum of ten years), store at 25°C (77°F) or lower at a relative humidity of 20 to 50 percent; for extended-term storage (for preservation of material having permanent value), store at 21°C (70°F) or lower at a relative humidity of 20 to 30 percent. For active use, store at 25°C (77°F) or lower, at a relative humidity of 50 +/- 5 percent; this relates to optimized film handling rather than preservation. Static, dust-attraction and curl-related problems are generally minimized at the higher relative humidity. After usage, the film should be returned to the appropriate medium- or long-term storage conditions as soon as possible. Store processed film according to the recommendations in ISO 18911:2010, Imaging Materials - Processed Safety Photographic Films - Storage Practices.

IMAGE STRUCTURE

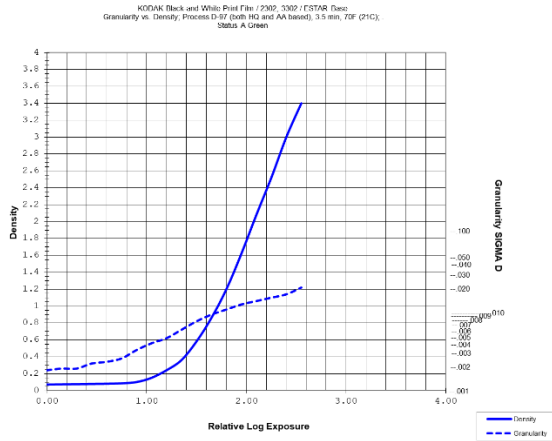
The modulation-transfer curves and the diffuse rms granularity data were generated from samples of 2302 Film exposed with tungsten light and processed as recommended in KODAK Developer D-97 at 70°F (21°C) to the recommended control gamma.

MTF



This graph shows a measure of the visual sharpness of this film. The x-axis, "Spatial Frequency," refers to the number of sine waves per millimeter that can be resolved. The y-axis, "Response," corresponds to film sharpness. The longer and flatter the line, the more sine waves per millimeter that can be resolved with a high degree of sharpness—and the sharper the film.

rms Granularity



PROJECTION

KODAK Black-and-White Print Film 2302 / 3302 offers superior performance during projection. The permanent humidity-independent anti-stat greatly reduces static charging of the film and annoying "shocks" and static discharge, even at the high transport speeds during rewinding and make-up onto platters. The anti-stat also helps reduce static attraction of dirt to the processed film during projection, resulting in longer print runs with less build-up of black dirt and cinch marks.

Process-surviving lubricants are incorporated into both the backing and the top layer (SOC) of the emulsion side to optimize transport characteristics and improve abrasion resistance.

Although prints made on 2302/3302 Film will perform well under a wide range of ambient conditions, projection facilities should try to maintain constant levels of temperature and humidity. Recommended conditions are 20 to 25°C (68 to 77°F), and 50 to 60 percent relative humidity. For optimum projection focus performance, processed prints should always be wound emulsion-in, in accordance with SMPTE Recommended Practice RP-39-1993. Normal 35 mm and 70 mm print orientation is with the emulsion-side toward the lamp, and the base-side toward the projection lens, per standard SMPTE 194-1991.

Because of the high tensile strength and tear resistance of polyester film, Kodak has always recommended the use of tension-sensor fail-safes (not just film-break detectors) to protect equipment and reduce film damage in the event of tension build-up due to a mis-thread or projector malfunction. A variety of fail-safes are available from theatre equipment dealers.

SPLICING

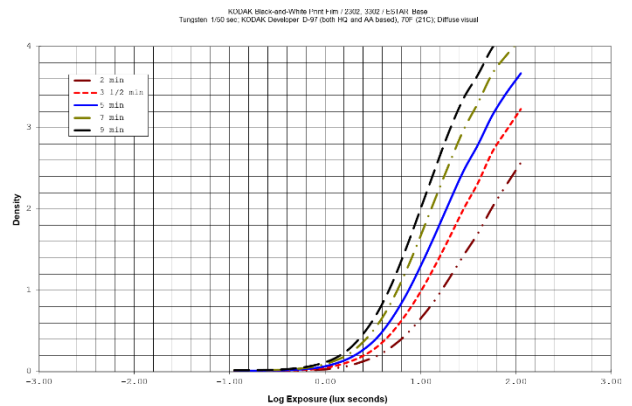
KODAK Black-and-White Print Film 2302 / 3302 is manufactured on ESTAR base. Since ESTAR base is impervious to most solvents, solvent-based "cement" splicing CANNOT be used.

Thermal-weld ultrasonic splicers may be used on both raw stock and processed film. After cutting, the two pieces of film are overlapped slightly and brought into contact with a horn that focuses acoustic energy from an ultrasonic transducer to the film overlap. A pressure roller brings the film into intimate contact with the horn, causing localized heating and fusion of the polyester support, creating a strong weld and reliable splice. Key splicing parameters are the acoustic frequency and power output, roller pressure, and roller transit time. Although the emulsion and backside layers become part of the polyester weld, there is usually no need to scrape them off prior to ultrasonic splicing.

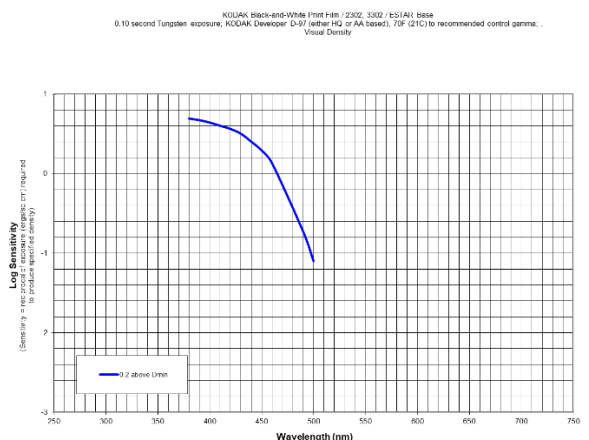
Adhesive tape splicing is often used in splicing rolls of printed raw stock prior to processing. Clear adhesive splicing tape is the most frequently used method of splicing processed prints in theaters, producing reliable splices on relatively inexpensive splicers that are simple to use.

CURVES

Characteristic Curve

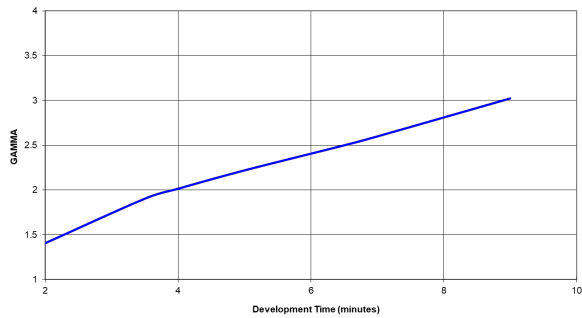


Spectral Sensitivity



Gamma

KODAK Black-and-White Print Film / 2302 / 3302 / ESTAR Base
KODAK Developer D-97 (both HQ and AA based) at 70°F

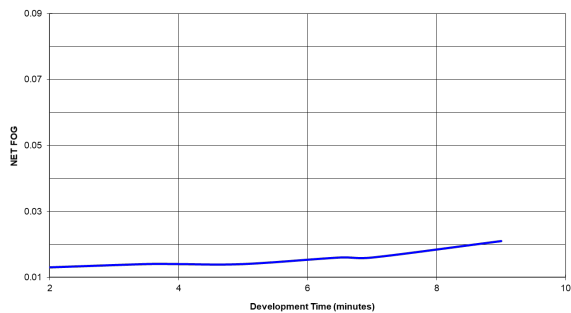


Gamma is a measure of the film contrast. Gamma is the slope of the straight-line portion of the characteristic curve. Slope refers to the steepness of a straight line determined by taking the change in density from two points on the curve and dividing that by the change in log exposure for the same two points. The formula for calculating gamma is $D\text{-min} + 0.95 \text{ density} + 0.50 \text{ LogE}$.

Net Fog

KODAK Developer D-97 (HQ) at 70°F

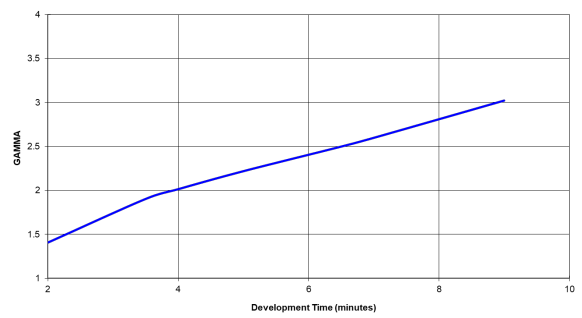
KODAK Black-and-White Print Film / 2302 / 3302 / ESTAR Base
KODAK Developer D-97 (HQ) at 70°F



The minimum density or smallest amount of density in a film is known as D-min; it is the density of the clear ESTAR base plus a little bit of "fog" in the emulsion. "NET FOG" is defined as D-min minus base density. The graph shows emulsion "fog" in density versus increasing development times through the hydroquinone (HQ) based D97 Developer.

KODAK Developer D-97 (AA) at 70°F

KODAK Black-and-White Print Film / 2302 / 3302 / ESTAR Base
KODAK Developer D-97 (both HQ and AA based) at 70°F



The minimum density or smallest amount of density a film has is known as the D-min; it is the density of the clear ESTAR base plus a little bit of "fog" in the emulsion. "NET FOG" is defined as D-min minus base density. The graph shows emulsion "fog" in density versus increasing development times through the ascorbic acid (AA) based D97 Developer.

NOTICE: The sensitometric curves and data in this publication represent product tested under the conditions of exposure and processing specified. They are representative of production coatings, and therefore do not apply directly to a particular box or roll of photographic material. They do not represent standards or specifications that must be met by Eastman Kodak Company. The company reserves the right to change and improve product characteristics at any time.

Available Roll Lengths and Formats

See Kodak Motion Picture Products Catalog at www.kodak.com/go/mpcatalog

To order film in the United States and Canada, call 1- 800-356-3259, prompt 3.

Worldwide customers can find the nearest sales office at www.kodak.com/go/salesoffices

