

Duplicating Microfilm Data Sheet

KODAK Duplicating (x462), Direct Duplicating (x468), Direct Duplicating Intermediate Microfilm (2470) and Positive Print Duplicating Microfilm (x440) (ESTAR Base)



Description

Kodak Duplicating Microfilms are silver-halide films designed for making high-quality duplicates of original camera and other duplicate microfilms. Depending on the film type used, these films can either maintain or reverse image polarity. These duplicating microfilms can be used in a variety of manufacturer's silver duplicators. *Kodak* Duplicating Microfilms are fine grain, high resolution microfilms with the exposure and development latitude to duplicate/enhance varying quality originals.

Product applications

Eastman Kodak Company produces a family of duplicating films (2462, 3462, 4462), a family of direct duplicating microfilms (2468, 3468, 4468), one direct duplicating intermediate microfilm (2470), and a family of positive print microfilms (2440, 3440, 4440). They all require conventional processing and can either maintain or reverse the original image polarity.

Kodak Duplicating, Direct Duplicating Microfilms and Positive Print Duplicating Microfilms are primarily intended for creating multiple distribution copies of camera film masters, and occasionally as intermediate print film masters, when creating large quantities of duplicates such that the original camera film is not at risk of damage. The *Kodak* Direct Duplicating Intermediate Microfilm is typically used as an intermediate print master but may also be used as a distribution copy. All duplicating microfilms use a "contact-printing" method, such that the master and duplicate are brought into intimate contact during exposure. A description of each follows.

BUSINESS
IMAGING
SYSTEMS

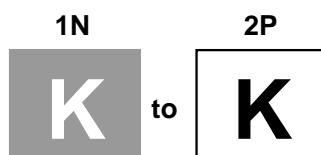


Kodak Duplicating Microfilm—x462



- Reverses image polarity (neg-to-pos or pos-to-neg) with conventional processing
- Blue spectral sensitivity
- Medium contrast
- Primarily used for making positive images of publications such as newspapers and magazines for frequent viewing

Kodak Positive Print Duplicating Microfilm—x440



- Reverses image polarity (neg-to-pos or pos-to-neg) with conventional processing
- Provides more of a neutral image tone than x462
- Blue spectral sensitivity
- Lower contrast and faster speed than x462
- Preferred when either poor quality originals or documents with low contrast images require duplication



Kodak Direct Duplicating Microfilm—x468

- Maintains image polarity (neg-to-neg or pos-to-pos) with conventional processing
- Orthochromatic color sensitivity (blue-green)
- Medium contrast
- Primarily used for making distribution copies

Kodak Direct Duplicating Intermediate Microfilm—2470 (*Estar* Base)



- Maintains image polarity (neg-to-neg or pos-to-pos) with conventional processing
- Orthochromatic color sensitivity (blue-green)
- Excellent tone reproduction
- Medium - low contrast
- Primarily used as an intermediate master to make multiple generation copies
- Can also be used as a distribution copy

Kodak Duplicating (x462), Direct Duplicating (x468), and Positive Print Duplicating Microfilms (x440) are available in three thicknesses

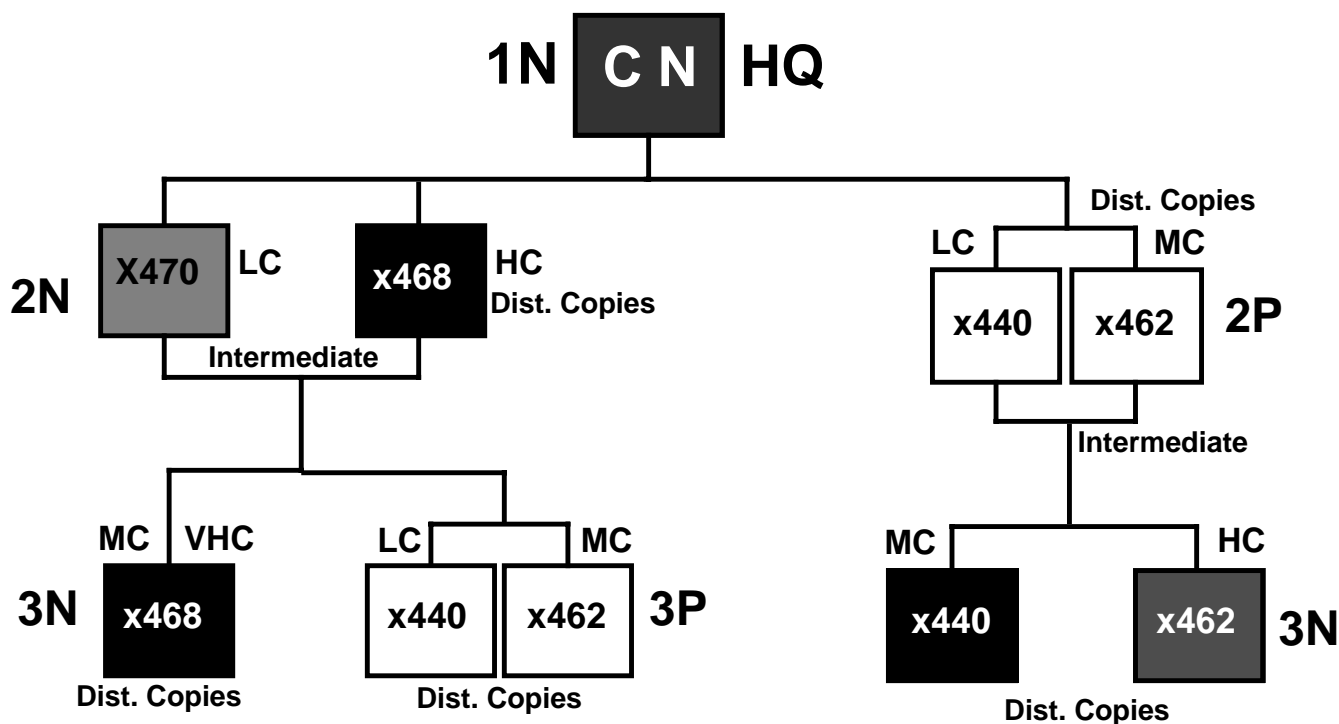
2440, 2462 & 2468 <i>Estar</i> Base 4.0 mil	Used in normal 16, 35 & 105 mm roll film applications
3440, 3462 & 3468 <i>Estar</i> Thin Base 2.5 mil	Used in 16 mm applications for reduced loading frequency, reduced film storage requirements and maximum image capacity per roll
4440, 4462 & 4468 <i>Estar</i> Thick Base 7.0 mil	Used for microfiche applications where more rigidity is required

Features common to all *Kodak* Duplicating Microfilms

- Life expectancy of 500 years (LE-500) when processed and stored properly, compared with 100 years (LE-100) for nonsilver duplicating films such as diazo and vesicular
- Ultra-high resolving power
- Static-resistant, process-survivable backing
- Micro-fine granularity
- Very slow speed
- Manufactured process is registered to ISO 9000
- Manufactured to ANSI and ISO standards specifications for films to be used for storing records of long-term or permanent value

The following "duplication tree" illustrates how the various duplicating microfilms are used to produce the desired contrast and image polarity of distribution copies. As an example, 3N is showing 3rd generation negative-appearing distribution copies.

LC = low contrast
MC = medium contrast
HC = high contrast
VHC = very high contrast



Physical properties

Nominal thickness data (mils)

Microfilm	Base* (mils <i>Estar</i>)	Total**
2440, 2462, 2468, & 2470	4.0	4.2
3440, 3462, 3468	2.5	2.7
4462, 4468	7.0	7.2
4440	7.0	7.1

*Static-resistant—process-survivable.

**Unprocessed.

Exposure

The following table indicates values for 1/25-second tungsten exposures calculated using the formula $45/H$, where H is the exposure in lux-seconds required for a density of .20 (1.20 for x440 and x462 Microfilms) above minimum density with indicated processing. This number can be used directly with incident-light meters.

Meter Setting Value*

x440, x462	2.1
x468	0.2
2470	0.12

*Recommended processes

Reciprocity data

For the Direct Duplicating Microfilms (x468 and 2470), tungsten exposures from 100 to 0.001 seconds, and processing in a *Kodak Prostar* Processor as recommended, reciprocity failure is negligible and no correction is normally needed. Similar results are expected with other recommended processes.

With Positive Print Microfilm x440 and Duplicating Microfilm x462 and using other than 1/50 second tungsten exposures, correct for reciprocity failure at a density of 1.20 above D-min as follows:

x462 Microfilms	Exposure Time (seconds)			
	100	10	1	1/10 to 1/100
Speed change (%)	-75	-50	-20	none
Effective meter setting*	0.5	1.0	1.6	2.1
Correction in camera stops	+2	+1	+1/3	none

*for *Kodak Prostar* Processor & continuous strand

x440 Microfilms	Exposure Time (seconds)		
	100	10	1 to 1/1000
Speed change (%)	-75	-20	none
Effective meter setting*	0.5	1.6	2.1
Correction in camera stops	+2	+1/3	none

*for *Kodak Prostar* Processor & continuous strand

Exposure guidelines - x468 and 2470

Print density decreases with increased exposure and increases with added development for the direct duplicating microfilms. For intermediate duplicating masters, generally the D-min in the master should be printed to the density in the following table. 2470 Microfilm is generally not used for distribution copies. If it is used as a distribution copy, reduce D-min levels to the levels indicated for x468 Microfilm.

Microfilm Exposure Control	
	Print D-min of master to a density on the duplicate as specified below:
x462	.08 to .15
x440	.06 to .20
x468	.10 to .15
2470	.15 to .25

Processing information

Processors and processing chemicals

Kodak Duplicating Microfilms can be processed in most typical continuous-strand type medium and deep-tank processors utilizing common *Kodak* Processing Chemicals and parameters. However, they are compatible with all standard microfilm processing equipment and high quality microfilm chemicals, although results may vary.

IMPORTANT: *For best results and to avoid aeration, always add chemical concentrate to water, **not** water to concentrate.*

Processor set up: Specifications for all *Kodak* Duplicating Microfilms†

Conventional Processor	Developer		Fixer		Wash Temp °F (°C)	Dry Temp °F (°C)	Dilution	
	Dwell Sec	Temp °F (°C)	Dwell Sec	Temp °F (°C)			Dev	Fix
<i>Kodak Prostar</i>	13.5	100 (37.8)	13.5	96 (35.6)	96 (35.6)	135 (57.2)	Ready to Use	Ready to Use
Deep tank	90*	85 (29.4)	45–90	85 (29.4)	80 (26.7)	160 Max (71.1)	1:7	1:3

†Starting points and mixed formats.

NOTE: The above dwell times and temperatures are starting points only. Specific systems or customer needs may demand variation from these values based on photographic aims. Dwell time is determined by timing film speed from entrance roller to exit roller while running in the processor. Deep tank times given should match the photographic results of a *Prostar* Processor; significantly shorter development times are achievable with these films by using higher exposure conditions without any detriment to image quality.

*For X462 Microfilms, the starting dwell time for the developer is 68 seconds.

Replenishment rates

Development/transport time and transport rates are set to achieve desired photographic aims; replenishment rate settings are determined by multiplying the transport speed by the required replenishment rates for the appropriate film width being used.

Use the chart and formula provided to determine the developer and fixer replenishment rates (mL/min) by multiplying transport speed (ft/min) (which is determined by dividing the path length of the developer tank in feet by the dwell time in seconds and multiplying by 60; see example) and the appropriate processor replenishment specification (mL/linear ft).

	Replenishment mL/Linear Ft					
	16 mm		35 mm		105 mm	
	Dev	Fix	Dev	Fix	Dev	Fix
<i>Kodak Prostar</i>	0.75	0.75	1.5	1.5	N/A	N/A
Deep tank	1.00	1.25	2.0	2.5	6.0	7.5

NOTE: *These are starting point recommendations.* Actual settings may require adjustments to maintain process activity levels. Shorter dwell times are acceptable; however, exposure adjustments will be necessary.

Transport speed X Replenishment/ feet of film = Replenishment rate
(ft/min) (mL/Lft) (mL/min)

A calculation of replenisher rate follows:

For Processor: *Allen M-70 Processor*
Type of Film: *35mm (2468 Microfilm)*
Dwell: *70 seconds*
Developer Film Path: *84 feet*

Replenishment (Dev): *2 (from table above)*
Calculated transport speed:

$$\frac{84 \text{ feet}}{70 \text{ sec}} \times 60 \text{ sec/min} = 72 \text{ feet/min} \quad (\text{transport speed})$$

Results:

72 feet/min x 2 mL/ft = 144 mL/min
replenishment rate for developer

Before-process handling and storage

Handling

Total safelight exposure, whether before or after image exposure, should not exceed 30 minutes. For darkroom handling, x468 and 2470 Microfilms should use a *Kodak 1 Safelight Filter / red* or *Kodak 2 Safelight Filter / dark red*, in a suitable safelight lamp with a 15-watt bulb, located at least 4 feet (1.2 metres) from the film. x440 and x462 Microfilms should use a *Kodak OA Safelight Filter / greenish yellow*, with the same lamp distance conditions. When using gooseneck lamps with contact printers, a *Kodak 1 Safelight Filter / red* is required.

Storage

For optimum life of Direct Duplicating Microfilms (x468 and 2470), keep unopened packages at 55°F (13°C), at 50-percent relative humidity or below, and protected from radiation and x-rays. Film stored at higher temperatures or humidities for a period of six months or more may lose photographic speed or D-max. Positive Print Microfilm (x440) and Duplicating Microfilm (x462) can be stored at 70°F (21°C) at 50 percent relative humidity or below, and protected from radiation and x-rays. To avoid moisture condensation on film that has been refrigerated, allow cold film to reach approximate room temperature before opening the package (about 3 hours if refrigerated, 5 hours if frozen).

After-process and storage information

Image stability and keeping

These microfilms are manufactured to ANSI and ISO specifications for extended term storage use. When processed as recommended, these microfilms meet both ANSI and ISO specifications for microfilms intended for long-term storage. These microfilms have a Life Expectancy LE-500 rating.

ANSI/NAPM IT9.1-1996, *Imaging Materials—Processed Silver-Gelatin Type Black-and-White Film—Specifications for Stability* and ISO 10602-1995, *Photography—Processed Silver-Gelatin Type Black-and-White Film—Specifications for Stability*, state that the maximum permissible concentration of thiosulfate ion is 0.014 grams per square metre (1.4 micrograms per square centimetre). Thiosulfate limits for Class 1 grain apply to this microfilm.

ANSI/NAPM IT9.11-1993, *American National Standard for Imaging Media—Processed Safety Photographic Films—Storage*, and ISO 5466-1996, *Photography—Processed Safety Photographic Films Storage Practices*, give appropriate conditions for extended term (permanent) and long-term storage films. Information is also available in *Kodak Publication D-31, Storage and Preservation of Microfilms*. Extended term storage conditions require a temperature of less than 70°F (21°C) and 30- to 40-percent RH for polyester base microfilm.

These ANSI and ISO Standards can be obtained by contacting: Association for Information and Image Management International (AIIM), 1100 Wayne Avenue, Suite 1100, Silver Spring, MD 20910-5603, Internet Web site <http://www.ansi.org> or by calling 301-587-8202.

NOTE: Refer to the latest revision of each ANSI or ISO Standard specified.

Image structure

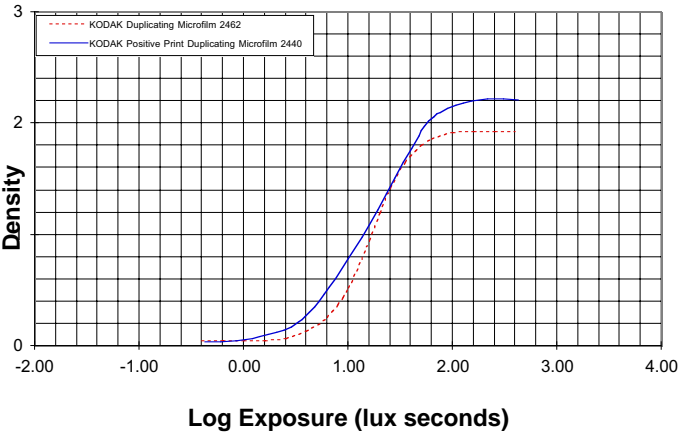
Resolving power: Based on recommended process.

Film	Test-Object Contrast	Lines/mm
X440, X462	1.6:1 (ISO-RPL) 1000:1 (ISO-RP)	250 630
x468	1.6:1 (ISO-RPL) 1000:1 (ISO-RP)	400 1,000
2470	1.6:1 (ISO-RPL) 1000:1 (ISO-RP)	400 1,000

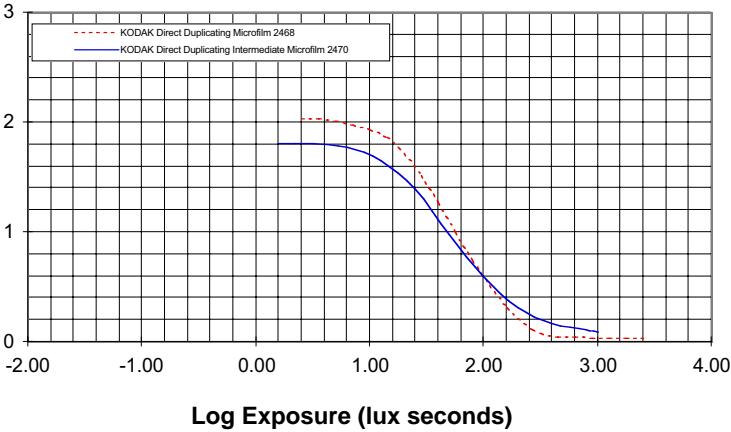
These values were determined according to a method similar to ANSI/ISO 6328-1982, *Photography—Photographic Materials—Determining of ISO Resolving Power*, except the light source used was a high-pressure mercury arc.

Characteristic curves

Kodak Positive Print Duplicating Microfilm 2440
Kodak Duplicating Microfilm 2462
 Kodak Microfilm Developer and Replenisher (1:7),
 Kodak Prostar Processor; Diffuse Visual



Kodak Direct Duplicating Intermediate Microfilm 2470
Kodak Direct Duplicating Microfilm 2468
 Kodak Microfilm Developer and Replenisher (1:7),
 Kodak Prostar Processor; Diffuse Visual

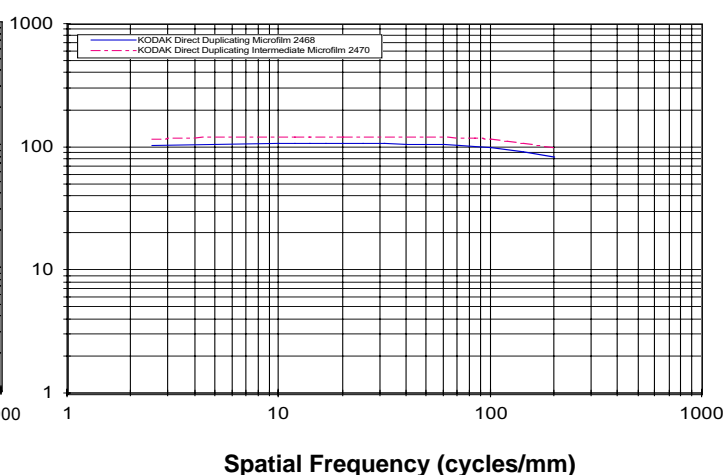
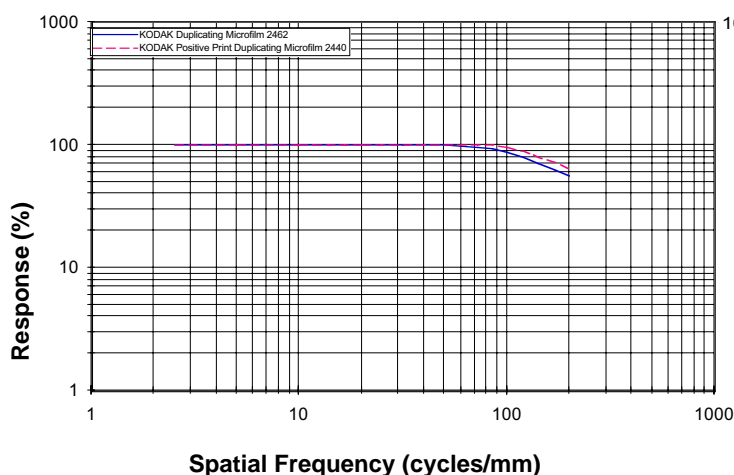


Notice: While the data presented are typical of production coatings, they do not represent standards which must be met by Eastman Kodak Company. Varying storage, exposure, and processing conditions will affect results. The company reserves the right to change and improve the product characteristics at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

Modulation transfer function curves

Kodak Positive Print Duplicating Microfilm 2440
Kodak Duplicating Microfilm 2462
 Tungsten; Kodak Prostar Plus Developer,
 Kodak Prostar Processors; Diffuse Visual

Kodak Direct Duplicating Intermediate Microfilm 2470
Kodak Direct Duplicating Microfilm 2468
 Tungsten; Kodak Prostar Plus Developer,
 Kodak Prostar Processors; Diffuse Visual



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Modulation transfer function

The MTF curve was determined using a method similar to that described in ANSI PH2.39-1977 (R1990), *Photographic Modulation Transfer Function of Continuous-Tone Black-and-White Photographic Films, Method of Measuring*.

These values were determined by a method similar to the one described in ISO 6328-1982, ANSI/ISO 6328-1982.

Diffuse RMS granularity

Determined at a net diffuse density of 1.00, using the aperture indicated.

	48-Micrometre Aperture Value	12-Micrometre Aperture Value
x440	6.5	n/a
x462	5	15
x468	less than 5	10
2470	less than 5	10

These values represent 1,000 times the standard deviation of density produced by the granular structure of the material when a uniformly exposed and developed sample is scanned with a densitometer calibrated to read American Standard diffuse visual density, and having a circular measuring aperture with the indicated diameter.

Granularity is an objective measurement of the spatial variation of sample density that generally correlates with graininess, which is the subjective effect of the image nonuniformity upon an observation when comparisons are made at the same density level.

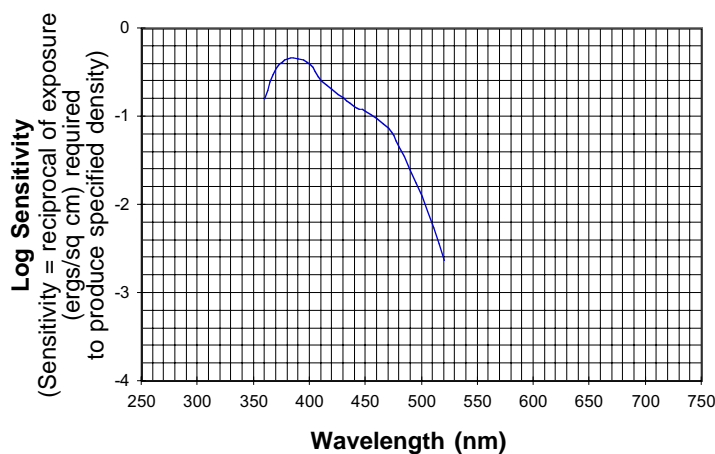
Broadly speaking, granularity measurements with the 48-micrometre aperture will indicate the magnitude of the graininess sensation produced by viewing the diffusely illuminated sample with 12X monocular magnification.

It should be noted that if the viewing conditions are changed from the specified conditions, the published RMS values may no longer correctly indicate the relative sensations of graininess produced by various samples.

Spectral sensitivity curves

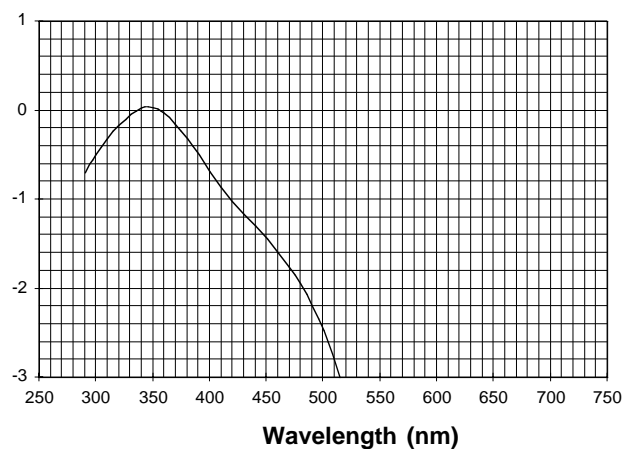
Kodak Positive Print Microfilm 2440/3440/4440

Effective Exp 1.4 sec; All recommended processes;
Diffuse Visual; D=1.0>D-min



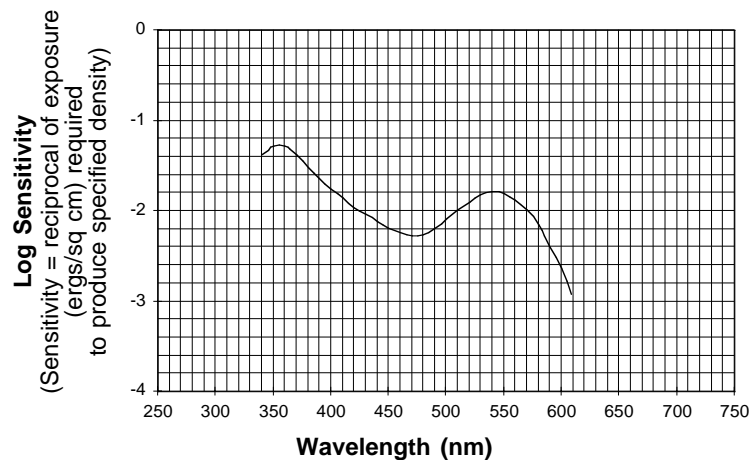
Kodak Duplicating Microfilm 2462/3462/4462

Effective Exp 1.4 sec; All recommended processes;
Diffuse Visual; D=1.0>D-min



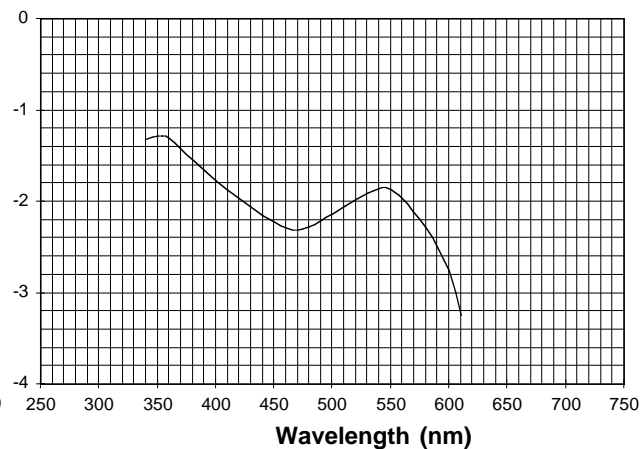
Kodak Direct Duplicating Microfilm 2468/3468/4468

Effective Exp 14 sec; All recommended processes;
Diffuse Visual; D=1.0>D-min



Kodak Direct Duplicating Intermediate Microfilm 2470

All recommended processes; D=1.0>D-min



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Ordering information: Microfilms

Code	Mil	Format	Spec	Desc	No./Case	CAT No.
2440	4	16 mm x 1080 ft	649	Type Z plastic core	10	148 9541
		16 mm x 1600 ft	649	Type Z plastic core	10	149 3097
		35 mm x 1000 ft	778	Type K plastic core	10	857 7223
		35 mm x 2000 ft	778	Type K plastic core	5	898 8644
3440	2.5			Special order only		
4440	7	105 mm x 500 ft	914	Paperboard core, no keyway	4	884 5919
2462	4	16 mm x 1000 ft	649	Type Z plastic core	10	833 2512
		16 mm x 1600 ft	649	Type Z plastic core	10	834 5191
		16 mm x 2000 ft	649	Type Z plastic core	10	843 8061
		35 mm x 100 ft	425	R200 black plastic spool	20	802 0315
		35 mm x 1000 ft	778	Type K plastic core	10	802 9720
		35 mm x 2000 ft	778	Type K plastic core	Pallet Pk	829 2716
		35 mm x 2000 ft	778	Type K plastic core	5	819 3492
		105 mm x 500 ft	914	Paperboard core, no keyway	4	813 6764
3462	2.5	16 mm x 2500 ft	649	Type Z plastic core	10	805 1617
4462	7	105 mm x 500 ft	914	Paperboard core, no keyway	4	836 3301
		105 mm x 500 ft	914	Paperboard core, no keyway	160	843 2668
2468	4	16 mm x 1000 ft	649	Type Z plastic core	10	810 5652
		16 mm x 1600 ft	649	Type Z plastic core	10	815 5608
		35 mm x 100 ft	663	Type U core 2-edge perf	50	177 4777
		35 mm x 1000 ft	778	Type K plastic core	10	811 3896
		35 mm x 1600 ft	778	Type K plastic core	5	841 2074
		35 mm x 2000 ft	778	Type K plastic core	5	801 0357
		105 mm x 500 ft	914	Paperboard core, no keyway	4	812 4232
3468	2.5	16 mm x 2500 ft	649	Type Z plastic core	10	803 3482
4468	7	105 mm x 250 ft	906	Type UU core	4	160 2457
		105 mm x 500 ft	914	Paperboard core, no keyway	4	801 9341
2470	4	16 mm x 1000 ft	649	Type Z plastic core	10	817 9749
		35 mm x 1000 ft	684	Type K plastic core	10	825 8345
		35 mm x 2000 ft	778	Type K plastic core	5	875 1778
		105 mm x 500 ft	914	Paperboard core, no keyway	4	827 4292

Ordering information: Chemicals

Chemical	CAT Number	Working Strength Solutions
Microfilm DEVELOPER and Replenisher—Concentrate		At 1:7 yields
1 gal—4/case	177 8869	32 gal
5 gal—1 cube	190 1891	40 gal
50 gal—1 drum	190 1917	400 gal
Microfilm FIXER and Replenisher—Concentrate		At 1:3 yields
1 gal—4/case	817 7222	16 gal
5 gal—1 cube	190 1149	20 gal
50 gal—1 drum	190 1164	200 gal
Kodak Prostar Processors:		Ready-to-use solution
Prostar Plus Developer 1 gal—4/case	102 2490	4 gal
Prostar Plus Fixer		
1 gal—4/case	102 2656	4 gal

Material Safety Data Sheets (MSDSs) on the chemicals (only) are available by calling: 1-800-242-2424, extension 43. You will need to supply *Kodak* CAT numbers of the chemicals for which you need MSDSs. Material Safety Data Sheets for the actual working solutions and caution labels for the processor tanks are also available by calling the same number.

READ THIS 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 which must be met by Eastman Kodak Company. The company reserves the right to change and improve product characteristics at any time.

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