

## Kodak Duplicating 2462/4462 Microfilm

### Kodak Direct Duplicating 2468/3468/4468 Microfilm

### Kodak Direct Duplicating Intermediate 2470 Microfilm



#### 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, 4462), a family of direct duplicating microfilms (2468, 3468, 4468) and one direct duplicating intermediate microfilm (2470). They all require conventional processing. Direct duplicating films maintain image polarity between generations. Duplicating microfilm reverses 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.

**Kodak Duplicating Microfilm — 2462/4462**



- 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 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 Direct Duplicating Microfilm — 2468/3468/4468**



- 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 silver-halide duplicating microfilms are available in three thicknesses as shown below:

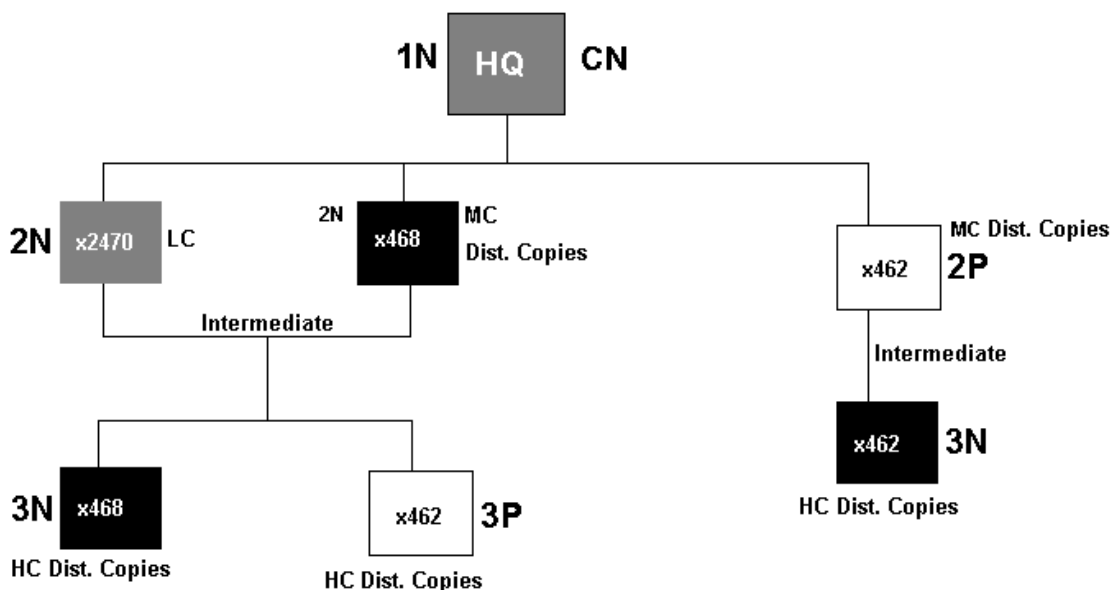
2462 and 2468 <i>Estar</i> Base 4.0 mil	Used in normal 16, 35 & 105 mm roll film applications
3468 <i>Estar</i> Thin Base 2.5 mil	Used in 16 mm applications for reduced loading frequency, reduced film storage requirements and maximum image capacity per roll
4462 and 4468 <i>Estar</i> Thick Base 7.0 mil	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.

CN = Camera Negative  
 LC = Low Contrast  
 MC = Medium Contrast  
 HC = High Contrast  
 1 = 1<sup>st</sup> generation  
 2 = 2<sup>nd</sup> generation  
 3 = 3<sup>rd</sup> generation  
 N = Negative polarity  
 P = Positive polarity  
 D = Distribution



### Physical properties

#### Nominal thickness data (mils)

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

\* Static-resistant—process-survivable

\*\*Unprocessed

### Exposure

The following table indicates value 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 .10 (1.20 for x462 Microfilm) above minimum density with indicated processing. This number can be used directly with incident-light meters.

#### Meter Setting Value\*

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 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 and 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
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.

NOTES: The 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.

$$\text{Transport speed (ft/min)} \times \text{Replenishment/feet of film (mL/Lft)} = \text{Replenishment rate (mL/min)}$$

### A calculation of replenisher rate follows:

For Processor: Allen M-70 Processor  
 Type of Film: 35 mm (2468 Microfilm)  
 Dwell: 70 seconds  
 Developer Film Path: 84 feet  
 Replenishment (Dev): 2 (from table above)  
 Calculated transport speed:

$$\frac{84 \text{ feet}}{70 \text{ sec}} \times 60 \text{ sec/min} = 72 \text{ feet/min}$$

(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 meters) from the film. 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. 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.

*ISO 19801 2002, 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 meter (1.4 micrograms per square centimeter). Thiosulfate limits for Class 1 grain apply to this microfilm.

ANSI ISO 18911 2000, *Photography — Processed Safety Photographic Films-Storage Practices*, gives 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 20- to 50-percent RH for polyester base microfilm.

These ANSI/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 website: <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

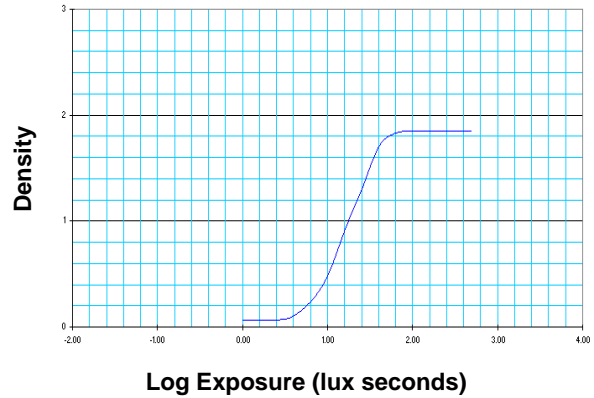
**Resolving power:** Based on recommended process.

Film	Test-Object Contrast	Lines/mm
x462	1.6:1 (ISO-RPL)	250
	1000:1 (ISO-RP)	630
x468	1.6:1 (ISO-RPL)	400
	1000:1 (ISO-RP)	1000
2470	1.6:1 (ISO-RPL)	400
	1000:1 (ISO-RP)	1000

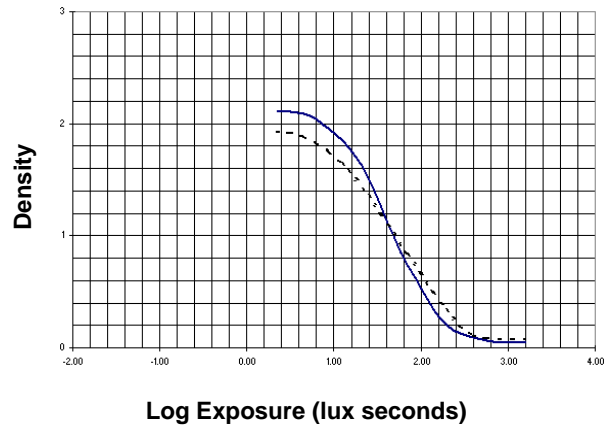
These values were determined according to a method similar to ANSI/ISO 6328-2000, *Photography — Photographic Materials — Determining of ISO Resolving Power*, except the light source used was a high-pressure mercury arc.

### Characteristic curves

**Kodak Duplicating Microfilm 2462/4462**  
Kodak Microfilm Developer and Replenisher (1:7),  
Kodak Prostar Processor, Diffuse Visual



**Kodak Direct Duplicating Intermediate Microfilm 2470**  
**Kodak Direct Duplicating Microfilm 2468/3468/4468**  
Kodak Microfilm Developer and Replenisher (1:7),  
Kodak Prostar Processor, Diffuse Visual



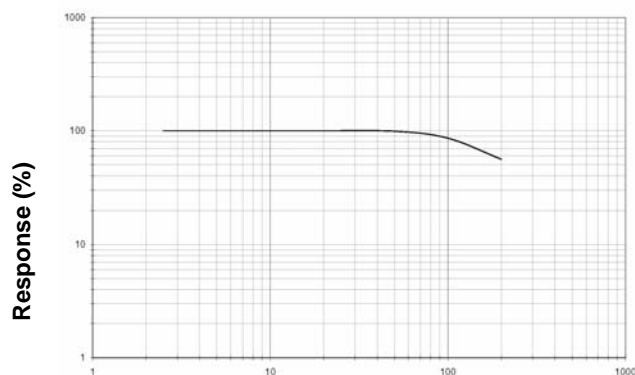
————— 2468/3468/4468  
- - - - - 2470

NOTE: 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 Duplicating Microfilm 2462/4462

Tungsten; Kodak Prostar Plus Developer,  
Kodak Prostar Processors; Diffuse Visual

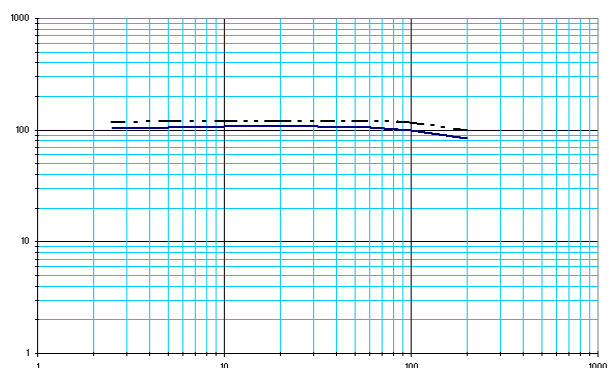


Spatial Frequency (cycles/mm)

### Kodak Direct Duplicating Intermediate Microfilm 2470

#### Kodak Direct Duplicating Microfilm 2468/3468/4468

Tungsten; Kodak Prostar Plus Developer,  
Kodak Prostar Processors; Diffuse Visual



Spatial Frequency (cycles/mm)

--- 2470  
— x468

NOTE: 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

The MFT 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*.

### Diffuse RMS granularity

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

	48-Micrometer Aperture Value	48-Micrometer Aperture Value
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.

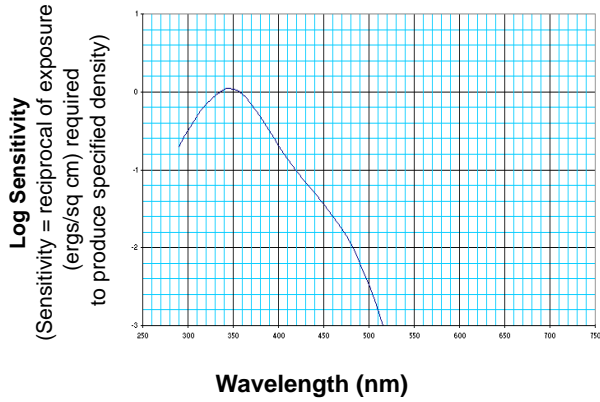
Broadly speaking, granularity measurements with the 48-micrometer aperture will indicate the magnitude of the graininess sensation produced by viewing the diffusely illuminated sample with 12X monocular magnification.

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

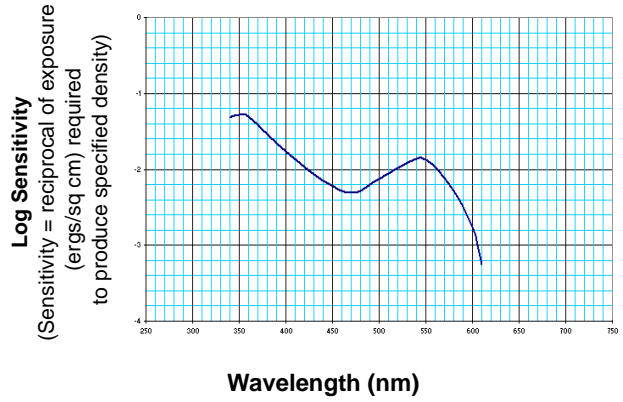
### Kodak Duplicating Microfilm 2462/4462

Effective Exp 1.4 sec; All recommended processes;  
Diffuse Visual;  $D=1.0>D\text{-min}$



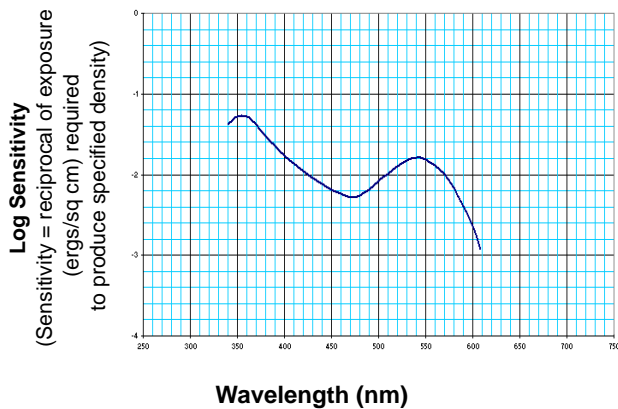
### Kodak Direct Duplicating Intermediate Microfilm 2470

All recommended processes;  $D=1.0>D\text{-min}$



### Kodak Direct Duplicating Microfilm 2468/3468/4468

Effective Exp 14 sec; All recommended processes;  
Diffuse Visual;  $D=1.0>D\text{-min}$



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### Ordering information: Microfilms

NOTE: Contact your Regional Sales Manager if you have any questions.

Code	Mil	Format	Spec	Description	No/Case	CAT No.
2462	4	16 mm x 1000 ft	649	Type Z plastic core	10	833 2512
		16 mm x 2000 ft	649	Type Z plastic core	10	843 8061
		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
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
		35 mm x 1000 ft	778	Type K plastic core	10	811 3896
		35 mm x 2000 ft	778	Type K plastic core	5	801 0357
3468	2.5	16 mm x 2500 ft	649	Type Z plastic core	10	803 3482
4468	7	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 No.	Working Strength Solutions
<b>Microfilm DEVELOPER and Replenisher — Concentrate</b>		at 1:7 yields
1 gal — 4/case	177 8869	32 gal
50 gal — 1 drum	190 1917	400 gal
<b>Microfilm FIXER and Replenisher — Concentrate</b>		at 1:3 yields
1 gal — 4/case	817 7222	16 gal
50 gal — 1 drum	190 1164	200 gal
<i>Kodak Prostar Processors</i>		Ready-to-use solution
<i>Prostar Plus Developer: 1 gal — 4/case</i>	102 2490	4 gal
<i>Prostar Plus Fixer: 1 gal — 4/case</i>	102 2656	4 gal

Material Safety Data Sheets (MSDSs) on the chemicals (only) are available by calling: 1-800-242-2424, ext. 43. MSDSs are also available at: [www.Kodak.com/eknec](http://www.Kodak.com/eknec). You will need to supply the Kodak catalog number 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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