

# KODAK High Speed Infrared Film



—NOTICE—

**Discontinuance of Sheet Format  
KODAK Speed Infrared Film / HSI / 4143**

Due to declining usage and demand, sheet sizes of KODAK High Speed Infrared Film / HSI will be discontinued when current supplies run out. We anticipate this will occur near the end of 2000.

Items to be discontinued are:

CAT No.	Film Code	Size (inches)
171 3015	4143	25 sheet 4 x 5
171 3056	4143	25 sheet 8 x 10

**Note:** KODAK High Speed Infrared Film will continue to be available in 35 mm format.

KODAK High Speed Infrared Film is a high-speed film with moderately high contrast, sensitive to light and radiant energy to 900 nanometres (nm) in wavelength. It is useful for haze penetration and for special effects in commercial, architectural, fine art, and landscape photography. With development variations, you can use this film for scientific, medical, aerial photography, and document copying. You can also use it for photomicrography, photomechanical, and remote-sensing applications.

Infrared films are sensitive to infrared radiation, some ultraviolet radiation, and to all wavelengths of visible radiation (light). They are not as sensitive to green light.

Whatever the ultimate purpose of your photographs, infrared photography provides unusual effects obtainable by few other means.

**Note:**

- Normal ISO speed values do not apply to this film.
- A filter is necessary for most applications.
- This film may not be suitable for a high degree of enlargement.

FEATURES	BENEFITS
• Moderately fine grain	• Good for producing high-quality infrared images
• Medium resolving power	• Good rendition of detail
• High-speed infrared sensitivity	• Expanded sensitivity versus other manufacturers' film infrared films—sensitivity ranges through the visible spectrum to about 900 nm in the infrared region
• Special sensitivity applications	• For aerial, astronomical, biological, documentary, industrial, laser, landscape, medical, and scientific photography • Suitable for distant haze penetration and abstract pictorial effects


## SIZES AVAILABLE

### Rolls

Roll	Base	Letter Code	CAT No.
135-36	4-mil ESTAR	HIE	169 2086

Size mm x ft	Base	Spec Code	Letter Code	CAT No.
35 x 150	4-mil ESTAR	417	HIE	160 4149

### Sheets

Sheets per Package	Size (inches)	Film Code	Base	Letter Code	CAT No.
25	4 x 5		7-mil ESTAR Thick	HSI	171 3015

## STORAGE AND HANDLING

Handle this film only in *total darkness*. Test your camera, film holders, processing equipment, and darkroom to ensure that they are opaque to infrared radiation. Load and unload your camera in *total darkness*. Store loaded film holders and cameras in subdued light, or total darkness if possible. Do not use a safelight during handling or processing.

Infrared films are susceptible to static markings at low relative humidity. If static problems persist, grounding the camera may be necessary to avoid a buildup of static electricity.

High temperatures or high humidity may produce unwanted quality changes. Store *unexposed* film at 55°F (13°C) or lower in the original package. Always store film (exposed or unexposed) in a cool, dry place. For best results, process film as soon as possible after exposure.

Protect *processed* film from strong light, and store it in a cool, dry place. For more information on storing negatives, see KODAK Publication No. E-30, *Storage and Care of Photographic Materials—Before and After Processing*.

## EXPOSURE

### Trial Exposures

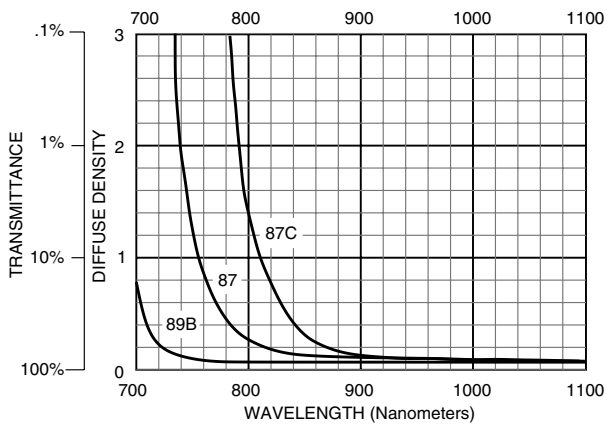
We cannot give exact speed numbers for this film because the ratio of infrared to visible energy varies, and most exposure meters measure only visible radiation. Make test exposures to determine the proper exposure for your application. For trial exposures under average conditions, use the meter settings in the table on page 3. Use these settings with exposure meters marked for ISO, ASA, or DIN speeds or exposure indexes; they are based on development in KODAK Developer D-76.

### Filters

To enhance the infrared effect on the film, you must use a filter over the lens (or light source) to absorb the ultraviolet radiation and blue light to which the film is also sensitive. A KODAK WRATTEN Gelatin Filter No. 25 (red) works well for most daylight applications. This filter blocks UV radiation and blue light; however, it passes red light that allows visual focusing. If you want to record *only* infrared radiation, use a filter that blocks all UV and visible radiation, such as KODAK WRATTEN Gelatin Filter No. 87, 87C, or 89B. Your choice of filter depends on the photographic effect you want to create.

#### Filters for Photography in the Infrared Region of the Spectrum

#### Filters for Photography in the Infrared Region of the Spectrum



Wavelength	Percent Transmittance of Infrared Filters		
	No. 87	No. 87C	No. 89B
700	—	—	11.2
10	—	—	32.4
20	—	—	57.6
30	—	—	69.1
40	0.8	—	77.6
50	3.5	—	83.1
60	12.3	—	85.0
70	22.1	—	86.1
80	33.2	—	87.0
90	44.9	0.55	87.7
800	56.9	3.0	88.1
10	63.2	8.3	88.4
20	68.0	16.2	88.6
30	73.3	25.7	88.8
40	76.3	38.0	89.0
50	78.5	48.4	89.2
60	79.5	57.5	89.4
70	80.4	65.3	89.6
80	80.7	72.5	89.8
90	81.4	78.5	89.9
900	81.9	80.6	90.0
10	82.1	82.2	90.1
20	82.7	83.3	90.2
30	83.1	84.7	90.3
40	83.4	85.6	90.4
50	83.6	86.4	90.5
60	84.0	87.2	90.5
70	84.3	87.7	90.5
80	84.6	88.3	90.5
90	84.9	88.8	90.5
1000	85.3	89.2	90.5
10	85.6	89.7	90.5
20	85.9	90.1	90.5
30	86.2	90.5	90.5
40	86.6	90.8	90.5
50	87.0	91.3	90.5
60	87.5	91.7	90.5
70	87.8	92.2	90.5
80	88.1	92.5	90.5
90	88.3	92.7	90.5
1100	88.5	93.0	90.5

## Film Speed

You cannot make exact meter readings to determine exposure for infrared films. Exposure meters are not calibrated for infrared radiation, and the ratio of infrared to visible radiation varies with the light source.

Make trial or bracketing exposures over a five-stop range to determine the proper exposure for your application. Under average conditions, use the following speed ratings to make starting-point exposures with *handheld meters or through-the-lens light meters*. For through-the-lens camera meters, make your readings before mounting the filter over the lens. Then ignore the meter reading/readout after attaching the filter.

Suggested Film Speeds Using a Handheld Light Meter		
KODAK WRATTEN Gelatin Filter	Daylight or Electronic Flash	Tungsten
No. 25, 29, or 89B	50/18°*	125/22°†
No. 87	25/15°	64/19°
No. 87C	10/11°	25/15°
No filter	80/20°	200/24°

\* If you are using a camera with a through-the-lens meter and a filter over the lens, use EI 200.

† If you are using a camera with a through-the-lens meter and a filter over the lens, use EI 500.

## Focusing

Lenses do not focus infrared radiation in the same plane as visible radiation. Because infrared radiation is longer in wavelength than visible radiation, the focus point is further from the camera lens. Therefore, the lens must be moved slightly farther from the film to focus an infrared image. This focus difference is most critical when using filters to block all visible radiation from the film.

Most camera lenses have an auxiliary infrared focusing mark. Consult your camera manual for the appropriate use.

For best definition, make all exposures at the smallest lens opening that conditions permit. If you must use large apertures and the lens has no auxiliary infrared focusing

mark, establish a focus setting by trial and error. Try extending the lens by 0.25 percent of its focal length beyond the correct focus for visible light.

For example, a 200 mm lens would require a 0.50 mm extension as  $200 \text{ mm} \times 0.0025 = 0.50 \text{ mm}$ .

## Daylight

For subjects in bright or hazy sunlight (distinct shadows):

Exposed through a KODAK WRATTEN Gelatin Filter No. 25		No Filter
Distant Scenes	Nearby Scenes	Distant Scenes
1/125 sec at f/11	1/60 sec at f/8	1/125 sec at f/16

## Electronic Flash

Use the appropriate guide number in the following table as a starting point for your equipment. Select the unit output closest to the number given by your flash manufacturer. Then find the guide number for feet or metres. To determine the lens opening, divide the guide number by the flash-to-subject distance. If the negatives are consistently too dense (overexposed), use a higher guide number; if they are too thin (underexposed), use a lower number.

Unit Output (BCPS)*	Guide Number Distances in Feet/Metres
350	20/6
500	24/7
700	30/9
1000	35/11
1400	40/12
2000	50/15
2800	60/18
4000	70/21
5600	85/26
8000	100/30

\* BCPS = beam candlepower seconds

## DARKROOM RECOMMENDATIONS

Do not use a safelight. Handle unprocessed film in total darkness.

Darkrooms must block all infrared radiation as well as light. Painted windows, plastic sheeting, etc., though opaque, may freely transmit infrared radiation and fog this film.

**Note:** Infrared films are susceptible to static markings at low relative humidity. Handle with care in the darkroom. If static electricity problems persist, grounding the camera may be necessary during loading and unloading to avoid a buildup of static electricity.

## EXPOSURE ADJUSTMENTS FOR LONG AND SHORT EXPOSURES

Multiply the normal (unfiltered) exposure time by the filter factor.

Indicated Exposure Time (sec)	Multiply Exposure Time by This Filter Factor
1/1000	1.25
1/100	1.0
1/10	1.0
1	1
10	1.0
100	1.6

## MANUAL PROCESSING

### Starting-Point Recommendations

The various pictorial, scientific, and technical applications of this film may require negatives of different contrast indexes. The following starting-point recommendations are intended to produce a contrast index close to that listed in the table. Make tests to determine the best development time for your application.

**Note:** Development times shorter than 5 minutes may produce unsatisfactory uniformity.

## Small-Tank Processing (8- or 16-ounce tank)—Rolls

With small single- or double-reel tanks, drop the loaded film reel into the developer and attach the top to the tank. Firmly tap the tank on the top of the work surface to dislodge any air bubbles. Provide initial agitation of 5 to 7 inversion cycles in 5 seconds; i.e., extend your arm and vigorously twist your wrist 180 degrees.

Then repeat this agitation procedure at 30-second intervals for the rest of the development time.

KODAK High Speed Infrared Film / HIE						
KODAK Developer	CI	Small Tank* Development Time (Minutes)				
		65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
XTOL	0.52	6 ½	5 ½	5	—	4
XTOL	0.58	7 ¼	6	5 ½	—	4 ½
XTOL	0.65	8	6 ¾	6	—	5
XTOL	0.75	9 ¼	7 ¾	7	—	5 ¾
XTOL	0.85	10 ½	9	8	—	6 ½
XTOL (1:1)	0.52	—	8	7 ½	—	6 ¼
XTOL(1:1)	0.58	—	8 ¾	8 ¼	—	7
XTOL (1:1)	0.65	—	9 ¾	9	—	7 ½
XTOL (1:1)	0.75	—	10 ¾	10	—	8 ½
XTOL (1:1)	0.85	—	12 ½	11 ½	9 ¼	7 ½
D-76	0.70	9 ½	8 ½	7 ½	7	6
HC-110 (Dil B)†	0.80	6	5	5	4 ½	4
D-19‡	1.65	7	6	5 ½	5	4
T-MAX (1.50 D-max)	0.65	—	—	—	—	4
T-MAX (1.76 D-max)	0.80	—	—	—	—	5
T-MAX (2.00 D-max)	0.91	—	—	—	—	6
T-MAX (2.36 D-max)	1.03	—	—	—	—	7
T-MAX (2.44 D-max)	1.15	—	—	—	—	8

\* With agitation at 30-second intervals. Development times shorter than 5 minutes may produce unsatisfactory uniformity.

† For scientific use

‡ For maximum contrast

## Tray Processing

Provide continuous agitation; rotate the sheets 90 degrees as you interleave them.

KODAK High Speed Infrared Film / HSI						
KODAK Developer	CI	Development Time (Minutes)				
		65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
D-76	0.70	11	9½	8½	7½	6½
HC-110 (Dil B)*	0.80	5	4½	4½	4¼	4
D-19†	1.65	5½	5	5	4½	4

\* For scientific use  
† For maximum contrast

## Large-Tank Processing (12- to 31/2-gallon tank)—Rolls and Sheets

Agitate continuously for the first 15 to 30 seconds by raising and lowering the basket, rack, or spindle 1/2 inch. Do not agitate the basket, rack, or spindle for the remainder of the first minute. Then agitate once per minute by lifting the basket, rack, or spindle out of the developer, tilting it approximately 30 degrees, draining it for 5 to 10 seconds, and reimmersing it. Alternate the direction of tilting the basket, rack, or spindle.

KODAK High Speed Infrared Film / HIE and HSI						
KODAK Developer	CI	Large Tank*—Rolls or Sheets Development Time (Minutes)				
		65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
XTOL	0.52	8 ½	6 ¾	6	—	4 ¾
XTOL	0.58	10	8	7	—	5 ½
XTOL	0.65	11 ½	9	8	—	6 ¼
XTOL	0.75	13	10 ¼	9	—	7
XTOL	0.85	14 ½	11 ½	10	—	7 ¾
D-76	0.70	10	9	8	7 ½	6 ½
HC-110 (Dil B)†	0.80	6 ½	5 ½	5½	5	4 ½
D-19‡	1.65	8½	7½	6½	6	5

\* With manual agitation at 1-minute intervals. Development times shorter than 5 minutes may produce unsatisfactory uniformity.  
† For scientific use  
‡ For maximum contrast

KODAK High Speed Infrared Film / HIE						
KODAK Developer	CI	Large Tank*—Rolls Development Time (Minutes)				
		65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX (1.50 D-max)	0.65	—	—	—	—	3
T-MAX (1.76 D-max)	0.80	—	—	—	—	4
T-MAX (2.00 D-max)	0.91	—	—	—	—	5
T-MAX (2.36 D-max)	1.03	—	—	—	—	6
T-MAX (2.44 D-max)	1.15	—	—	—	—	7

\* With manual agitation at 1-minute intervals. Development times shorter than 5 minutes may produce unsatisfactory uniformity.

## FINAL STEPS IN TANK, TRAY AND ROTARY-TUBE PROCESSING—

65 to 75°F (18 to 24°C)

Step/Solution	Time (min:sec)
<b>Rinse</b> —with agitation:	
KODAK Indicator Stop Bath	0:30
KODAK EKTAFLO Stop Bath	0:30
<b>Fix</b> —with frequent agitation:	
KODAK Fixer	5:00 to 10:00
KODAK Rapid Fixer	2:00 to 4:00
KODAFIX Solution	5:00 to 10:00
KODAK POLYMAX	5:00 to 10:00
<b>Wash:</b>	
Running water —OR— Rinse with water KODAK Hypo Clearing Agent Running water	20:00 to 30:00  0:30 1:00 to 2:00 5:00
<b>Final rinse:</b>	
KODAK PHOTO-FLO Solution	0:30
<b>Dry</b> —in a dust-free place	

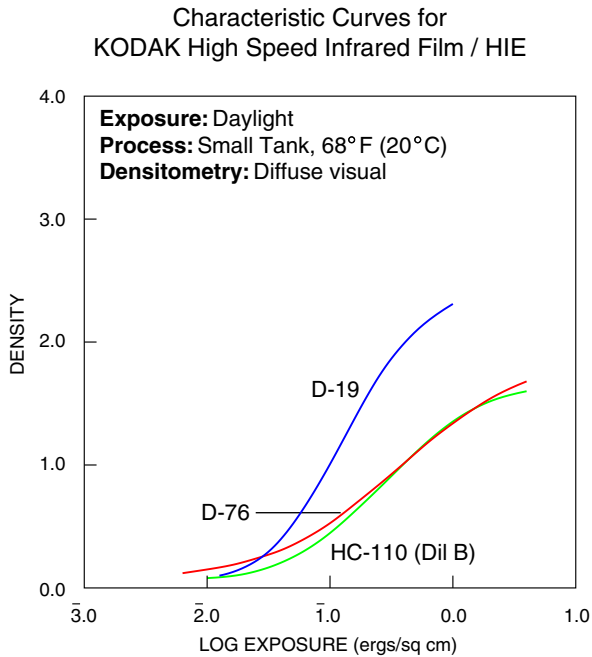
# IMAGE-STRUCTURE CHARACTERISTICS

The following information is based on development in KODAK D-76 Developer, 68°F (20°C), for 10 minutes.

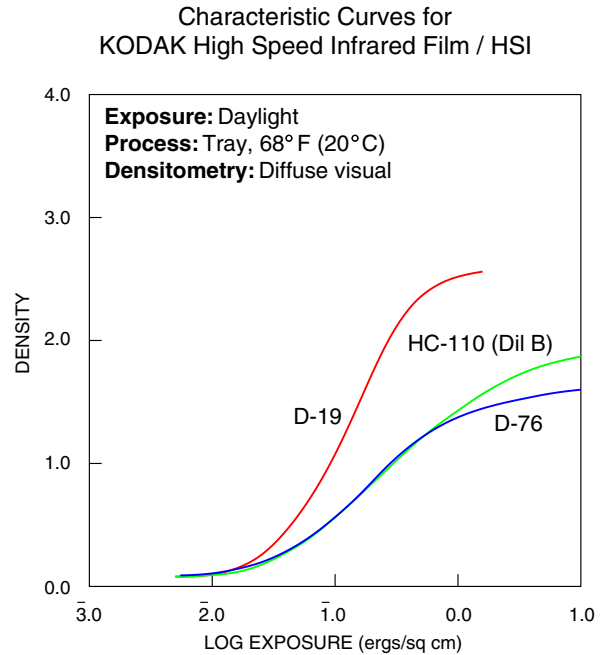
KODAK High Speed Infrared Film / HIE and HSI	
Diffuse rms Granularity*	18 Fine

\* Read at a net diffuse density of 1.0, using a 48-micrometre aperture, 12X magnification.

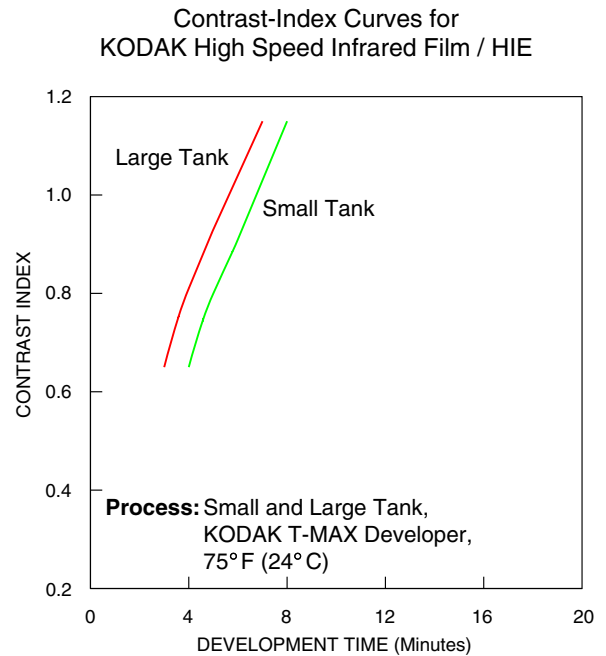
## Characteristic Curves for KODAK High Speed Infrared Film / HIE



## Characteristic Curves for KODAK High Speed Infrared Film / HSI



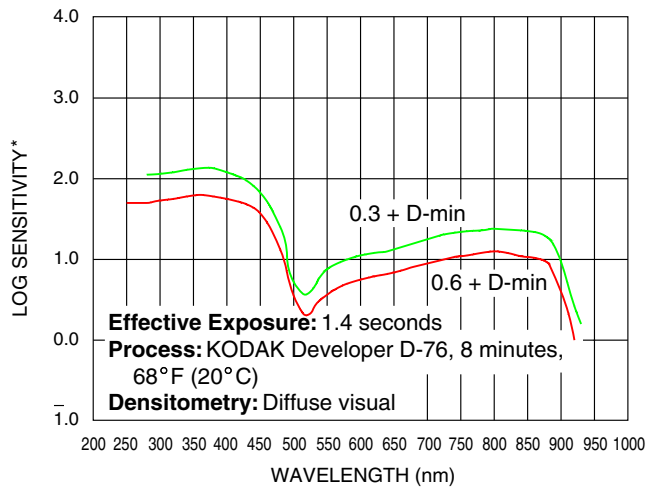
## Contrast-Index Curves for KODAK High Speed Infrared Film / HIE



**Spectral-Sensitivity Curves for  
KODAK High Speed Infrared Film / HIE and HSI**

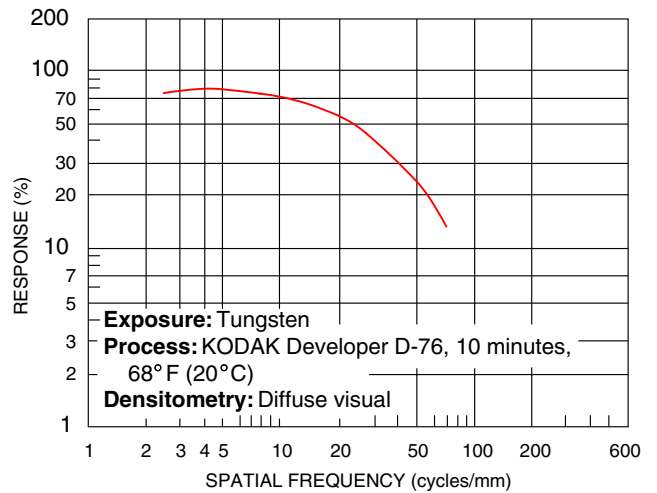
**Modulation-Transfer Curves for  
KODAK High Speed Infrared Film / HIE and HSI**

Spectral-Sensitivity Curves for  
KODAK High Speed Infrared Film / HIE and HSI



\*Sensitivity = reciprocal of exposure (ergs/cm<sup>2</sup>) required to produce specified density

Modulation-Transfer Curves for  
KODAK High Speed Infrared Film / HIE and HSI



**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.

# KODAK High Speed Infrared Film

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## MORE INFORMATION

Kodak has many publications to assist you with information on Kodak products, equipment, and materials.

Additional information is available on the Kodak website and through the U.S.A./Canada faxback system.

The following publications are available from Kodak Customer Service, from dealers who sell Kodak products, or you can contact Kodak in your country for more information.

E-30	<i>Storage and Care of KODAK Photographic Materials—Before and After Processing</i>
E103BF	<i>KODAK PROFESSIONAL Black-and White Films</i>
E103CF	<i>Chemicals for KODAK PROFESSIONAL Black-and-White Films</i>
J-24	<i>KODAK HC-110 Developer</i>
J-78	<i>KODAK Developers D-76</i>
J-86	<i>KODAK T-MAX Developers</i>
J-109	<i>KODAK XTOL Developer</i>
K-4	<i>How Safe Is Your Safelight?</i>

For the latest version of technical support publications for KODAK PROFESSIONAL Products, visit Kodak on-line at:  
**<http://www.kodak.com/go/professional>**

Many technical support publications for KODAK PROFESSIONAL Products can be sent to your **fax** machine from the Kodak Information Center. Call:  
**U.S.A. 1-800-242-2424, Ext. 33 / Canada 1-800-295-5531 — Available 24 hours a day, 7 days a week—**

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In the U.S.A.:  
1-800-242-2424, Ext 19 Monday–Friday  
9 a.m.–7 p.m. (Eastern time)  
In Canada:  
1-800-465-6325, Monday–Friday  
8 a.m.–5 p.m. (Eastern time)

**Note:** The Kodak materials described in this publication for use with KODAK High Speed Infrared Film are available from dealers who supply KODAK PROFESSIONAL Products. You can use other materials, but you may not obtain similar results.

## Kodak Professional