

# KODAK INDUSTREX High Speed HS800 Film



KODAK INDUSTREX HS800 Film is our fastest and most versatile film for non-destructive testing. Now you can use one film for any exposure method—direct, lead screen, fluorescent screen, or fluorometallic screen. Combined with KODAK LANEX Fast Screens, HS800 Film offers more speed than any film-screen combination available today. Designed for any high-density application where speed is an advantage, HS800 Film is suitable for structural components such as bridges, concrete, or off-shore pipelines.

When used with fluorescent or fluorometallic screens, HS800 Film displays high contrast throughout an extended range of optical densities, thus providing high sensitivity to flaw detection and wide exposure latitude.

HS800 Film incorporates KODAK's patented T-GRAIN Emulsion technology—just as effective in short automatic and manual processing cycles. Processed HS800 Film was designed to have cold image tone on the view box and high gloss, resulting in better perceived radiographs.

**Features:**

- High speed radiographic film for both direct and indirect x-ray exposure
- High response to fluorescent and fluorometallic screens
- High contrast with fluorescent and fluorometallic screens
- Medium grain
- Rapid automatic and manual processing
- Suitable for low and high voltage equipment, including gamma-ray sources
- For concrete and heavy construction, offshore pipeline, and thick wall casting applications

**Thickness**

Base / Support	0.18 mm (7.0 mils)
Emulsion	25 microns (1.0 mil); 12.5 microns each side
Overcoat	10 microns (0.4 mil); 5 microns each side
Total	0.22 mm (8.4 mils)

**Classification**

There are no test methods or minimum requirements that correspond to film system classes for film exposed with light-emitting intensifying screens.

**Available Packaging Formats****Sheet Film****Non-Interleaved (NIF) (HS800-1):**

This form of packaging is generally supplied in packs of 100 sheets in 30 x 40 cm and 14 x 17 inch sizes, and is for use when film is to be loaded into metal or plastic cassettes, or exposure holders, with or without screens.

**Roll Film****NIF bulk roll (HS800-359):**

The film is supplied on a cardboard core in 70 mm x 150 mm rolls. The film must be loaded into a cassette in a darkroom.

## Safelight Recommendations

Use a red safelight filter (i.e., KODAK 1, 1A, or 2 Safelight Filter) in a suitable safelight lamp equipped with a 15-watt bulb. Keep the film at least 4 feet (1.2 metres) from the safelight.

**Note:** Other safelight filters (i.e., KODAK 8 and GBX-2 Safelight Filter) which block radiation at 550nm and shorter wavelengths are also suitable for use.

## Storage and Handling

To avoid damage to the film both before and after processing, film should always be handled with care, avoiding any type of pressure on the film or any sharp bending of the film. Very high-speed x-ray films, such as HS800 Film, are photosensitive to physical handling marks that occur prior to processing. Pressure to the film's surface can cause minus density marks to develop, such as might result from kinking the film or pressure from debris inside cassettes or screens. To avoid these types of handling artifacts, carry a single sheet of film, handling it carefully by the two opposite corners. Alternatively, gently bend the film in half and grasp it with your thumb and middle finger and place your index finger in between to keep the film surfaces separated. Keeping the long dimension parallel to the floor is easier.

It is important to realize that meeting the chemical and physical requirements does not by itself ensure that records will not deteriorate. It is essential to provide proper storage conditions. ASTM E 1254 gives details of storage conditions. ISO 18911 and ISO 18902 give, for processed films, recommended storage conditions and specifications for the respective enclosure materials.

### Unexposed

50 to 70° F (10 to 21° C), 30 to 50% RH. Properly shield from x-rays, gamma rays, or other penetrating radiation.

### Exposed

Keep cool, dry, and properly shielded from penetrating radiation. Process as soon as possible after exposure.

### Processed

60 to 80° F (15 to 27° C), 30 to 50% RH.

## Relative Exposure

M100 Film in 8 min 79° F (26° C) cycle is assigned a relative exposure of 1.00. Exposure in accordance with EN 584-1 Lead screens.

KODAK INDUSTREX Films	KODAK INDUSTREX M431C Processor KODAK INDUSTREX Chemicals
	8 min 79° F (26° C)
HS800	0.13
AA400	0.3
T200	0.4
MX125	0.7
M100	1.0
DR50	1.7

## Intensifying Screens

Modern industrial x-ray films incorporate emulsions mostly sensitive in the blue region of the electromagnetic spectrum. Calcium tungstate ( $\text{CaWO}_4$ ) was chosen as the luminescent material in intensifying screens because it emits light in the blue range with an emission maximum at about 420nm. More recently, phosphors such as oxysulfides of the rare earth elements have been used to produce ultra fast screens. Rare earth phosphors also emit light in the blue range to which the emulsion is mostly sensitive.

## Fluorescent Screens

Fluorescent screens can sometimes be used with advantage for industrial radiography. The normal calcium tungstate type screens will not reduce scatter, and the image quality of radiographs where the exposure has been made using these screens is not as good as that obtainable with lead screen exposures. However, calcium tungstate screens permit a considerable reduction in exposure, being most responsive to X-rays and intensifying by a factor of approximately 100 times.  $\text{CaWO}_4$  fluorescent screens are much less responsive to gamma rays (approximately 20-40 times), and the inherent low contrast of gamma radiographs plus the unsharpness caused by these screens will result in poor sensitivity and fault detection.

## KODAK LANEX Fast Screens

KODAK LANEX Fast Screens have a thin clear overcoat to resist surface abrasion and have a backing layer to eliminate curl. They incorporate as phosphor terbium-activated gadolinium oxysulfide,  $\text{Gd}_2\text{O}_2\text{S:Tb}$ , coated in a transparent binder. These screens, incorporating a rare-earth phosphor from the lanthanide series, have significantly much higher X-ray absorption and X-ray energy conversion than calcium tungstate ( $\text{CaWO}_4$ ) screens. Accordingly, KODAK LANEX Fast Screens permit a greater reduction in exposure than  $\text{CaWO}_4$  screens. KODAK LANEX Fast Screens yield excellent images when used with HS800 Film.

KODAK LANEX Fast Screens will be provided in asymmetrical pairs. The phosphor coverage of the non-tube (back) screen is more than twice that of the tube-side (front) screen. This allows for optimized light output from each of the screens during exposure.

## Fluorometallic Screens

Fluorometallic screens combine the advantages of both fluorescent and lead screens. They consist of a  $\text{CaWO}_4$  layer combined with a lead layer and will permit useful reductions in exposure—depending upon energy and exposure duration. Image definition is far better than with ordinary fluorescent screens, and the higher contrast produced by the light image emitted helps improve sensitivity of flaw detection.

## Screen Care

The temperature encountered in most industrial radiography laboratories does not significantly affect screen emission. However, it is noteworthy that screen emission increases as screen temperature is lowered.

Intensifying screens must be kept away from chemicals and other sources of contamination. Every effort should be made to avoid soiling intensifying screens. Should they become dirty, they must be carefully cleaned according to the manufacturer's recommendations.

Under normal use conditions, intensifying screens will deteriorate. The deterioration may occur from abrasion of the protective overcoat or inadvertent physical damage to the surface. Certain chemical agents—such as non-approved screen cleaners, hand lotions, topical medications, foodstuff, etc.—may also damage the screens. Some screen deterioration may result in artifacts on processed radiographs. As a general rule, KODAK intensifying screens in cassettes should be replaced at least every 5 years.

When screens are replaced for normal wear and tear, the cassette should also be considered for replacement, installing new screens in well worn cassettes may not improve image quality. All cassettes and screens should be inspected systematically for screen-film contact, light-tight integrity (including hinges) and general condition. To inspect screens, make a uniform exposure on a film sufficient to produce a density of 1.9 to 2.5. Examine the processed film for screen-related artifacts.

Experience indicates that best results are obtained by cleaning KODAK intensifying screens with KODAK Intensifying Screen Cleaner and Antistatic Solution or with KODAK MIN-R Screen Cleaner. Some other screen-cleaning agents may leave residues which would seriously affect the emission of these screens and may affect the photographic response of the film. The use of any cleaning agents other than those specifically suggested for cleaning KODAK Intensifying Screens is not recommended.

## Antistatic Treatment of KODAK Intensifying Screens

KODAK Intensifying Screens and Films are designed to minimize the sources of static marks on the processed radiograph. If static should occur, KODAK Screen Cleaner or KODAK MIN-R Screen Cleaner wipes can be used. Apply the solution to the screens with a clean, lint free pad. Do not wipe screens dry. Allow screens to air-dry completely before returning them to service.

## Exposures with Fluorescent and Fluorometallic Screens

The reciprocity law is accurate for direct x-ray and lead screen exposures.

When determining exposure conditions for radiography without screens or with lead screens, relationships such as mA/time and the inverse square law for time/distance calculations are such that a known change of mA or distance will result in a precise change of time.

However, for exposures to the light emitted from fluorescent and fluorometallic screens, the reciprocity law fails to apply. Because of this, it is not possible to give an intensification factor that applies to all exposure conditions.

## Automatic Processing

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

See publication TI-2621, *Processing KODAK INDUSTREX Films*, for additional information on automatic processing.

### Film Characteristics: Lead Screen Exposure

EXPOSURE CONDITIONS: 200/220 kV, ISO/ANSI/EN Conditions, KODAK INDUSTREX Single Part Developer Replenisher and KODAK INDUSTREX LO Fixer and Replenisher

#### Film Characteristics (Sensitometric)

KODAK INDUSTREX Processor / Cycle	Base + Fog	Contrast*
M43IC, 8 min 79° F (26° C)	0.22	4.4
M43IC, 5 min 86° F (30° C)	0.23	4.3
M35, 8.5 min 82° F (28° C)	0.24	4.4

\* Contrast calculated between net densities of 1.5 and 3.5.

### Film Characteristics: Fluorescent or Fluorometallic Screens

EXPOSURE CONDITIONS: 80 kV, fluorescent or fluorometallic screens, KODAK INDUSTREX Single Part Developer Replenisher and KODAK INDUSTREX LO Fixer and Replenisher, M43IC processor, 8 min 79° F (26° C) cycle

#### Film Characteristics (Sensitometric)

Screen	Base + Fog	Relative Exposure	Contrast
KYOKKO SMP 308 screens	0.22	1.8	4.1
RENNEX screens	0.23	1*	4.1
KODAK LANEX Fast Screens	0.23	0.25	4.8

\* HS800 Film used in combination with RENNEX screens is assigned a relative exposure of 1.

## Recommended Replenishment Rates

The consistency of the radiographic quality is related to the accurate adjustment of the replenishment rate.

Replenishment should maintain the chemical equilibrium, replacing the components used by the film.

Solution	Replenishment Volume	
	per 314 x 17 inch sheet	per m <sup>2</sup>
Developer	100 mL	665 mL
Fixer	180 mL*	1200 mL

\* For optimum archivability, a 10% increase in fixer replenishment rate may be desirable.

## Washing and Drying

### Washing:

Follow the processor manufacturer's recommendation for wash flow rate, or adjust flow to achieve the equivalent of the wash tank capacity every five minutes, or twelve tank volumes per hour. Insufficient wash flow can adversely affect the life expectancy of processed radiographs. Wash flow rate should be increased if chemical spot tests or other analytical methods reveal a high level of retained chemicals in the processed film. For best results, the wash tank should be drained daily and left empty when not in use.

### Drying:

Follow the processor manufacturer's recommendation for dryer settings. In general, the dryer should be set to a temperature slightly above (3° C/5° F) the lowest temperature required to eliminate any signs of tackiness in films exiting the dryer.

## Manual Processing

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

See publication TI-2643, *Guide to Manual Processing of NDT Films*, for additional information on manual processing.

EXPOSURE CONDITIONS: 200/220 kV, lead screens, ISO/ANSI/EN Conditions, KODAK INDUSTREX Single Part Developer Replenisher

#### Film Characteristics (Sensitometric)

Development Conditions	Base + Fog	Contrast*
5 min 68° (20° C)	0.23	2.6
2 min 79° F (26° C)	0.25	2.6

\* Contrast calculated between net densities of 1.5 and 3.5.

## Development

Develop with rack and tank, using properly replenished solutions.

	Temperature	Recommended Time (Minutes)	Agitation
KODAK INDUSTREX Single Part Developer Replenisher	68° F (20° C) 72° F (22° C) 75° F (24° C) 79° F (26° C)	5 4 3 2	Intermittent (5 seconds every 30 seconds)

- Remove film and hanger 5 seconds before end of development. **DO NOT ALLOW EXCESS DEVELOPER TO DRAIN BACK INTO THE TANK.** Normally this will carry out the proper amount of solution to permit correct replenishment.
- Use floating covers on developer tanks to reduce oxidation and evaporation; store developer replenisher in a closed container.
- Fill the developer and fixer tank to its original level each morning with developer or fixer replenisher solution (topping off).
- Discard solution after adding two tank volumes of replenisher to tank, or at least once a month, and refill with fresh solution.

## Stop, Fix, Wash and Dry Steps

	Temperature	Recommended Time	Agitation
KODAK Indicator Stop Bath, or acetic acid (diluted to 3.5%) solution	60 to 85° F 16 to 30° C	30 to 60 seconds	Continuous, Moderate
KODAK Rapid Fixer, or KODAK INDUSTREX LO Fixer and Replenisher	60 to 85° F 16 to 30° C	3 to 6 minutes, or twice the clearing time	Vigorous for 15 seconds, then intermittent (5 seconds every 30 seconds)
Running water wash (8 volume changes per hour)	60 to 85° F 16 to 30° C	10 to 30 Minutes	

Stop baths check development, prevent most spots or streaks, and prolong the life of the fixing bath.

Immerse the film in fixer for **3 to 6 minutes**, agitating for **5 seconds every 30 seconds**. Film should remain in fixer for twice the time it takes to “clear” it (when the milky look disappears). **Never fix film for less than 3 minutes.**

KODAK Hypo Clearing Agent may be used following the fixer to reduce washing time and conserve water. First rinse films in running water for 30 seconds, then use Hypo Clearing Agent for 1 to 2 minutes, followed by a final running water wash for 5 minutes.

To minimize water spots and drying marks, use KODAK PHOTO-FLO Solution after washing.

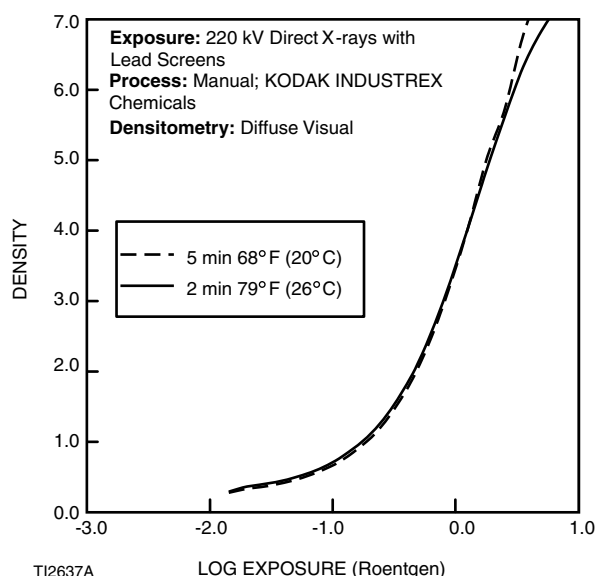
Dry in a dust-free area at room temperature or in a suitable drying cabinet. Temperature not to exceed 120° F (50° C).

## Recommended Replenishment Rates

Maintain chemical activity and solution level in the developer tank by adding 100 mL (3.38 fluid ounces) of replenisher according to instructions for each 14 x 17 inch sheet of film processed. Stir vigorously after each addition. Replenish the fixer tank at the rate of 180 mL (6 fluid ounces) per 14 x 17 inch sheet of film processed.

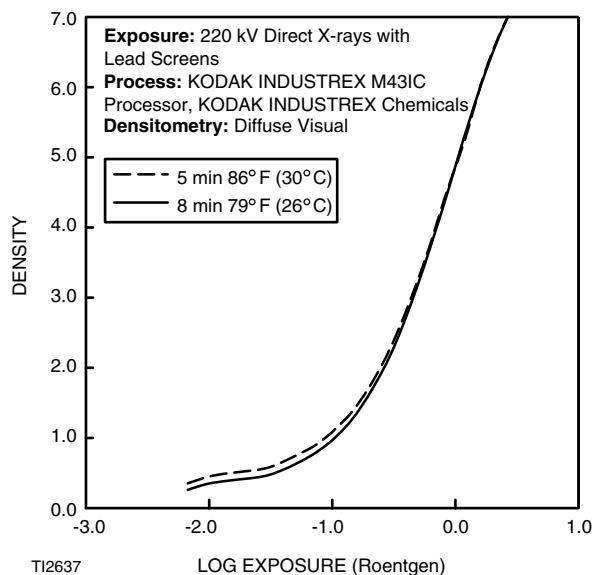
## Curves

### Characteristic Curves, Manual Processing

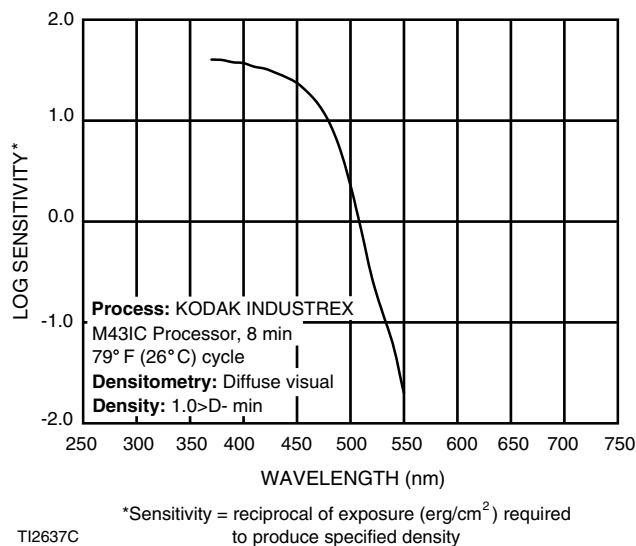


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## Characteristic Curves, Automatic Processing



## Spectral Sensitivity



NOTICE: While the sensitometric data in this publication are typical of production coatings, they do not represent standards which must be met by Carestream Health, Inc. Varying storage, exposure, and processing conditions will affect results. The company reserves the right to change and improve product characteristics at any time.

## Carestream

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