

# **X-Rite<sup>®</sup> 334**

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*Battery Operated  
Dual Color Sensitometer*

Operation Manual

**CAUTION:** Reverse connection of battery may cause damage to circuit. Use only 9 volt alkaline batteries.

**VORSICHT:** Eine Umkehrung der Akkuverbindung wird möglicherweise Schäden in der Schaltung verursachen. Verwenden Sie nur Alkalibatterien von 9 Volt.

**ADVERTENCIA:** Conexión inversa de las pilas causaría daño al circuito. Use solamente las pilas alcalinas de 9 voltios.

**ATTENTION:** Une liaison inversée des piles peut endommager le circuit. Utilisez seulement des piles fer-nickel de 9 volts.

**AVVERTIMENTO:** Connessione inversa delle pile può causare danno al circuito. Usare solamente le pile alcaline di 9 volt.

## **FCC**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## **Canada**

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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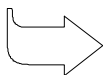
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*Dear Customer:*

*Congratulations! We at X-Rite are proud to present you with the X-Rite 334 Sensitometer. This instrument represents the very latest in low power integrated circuit design. As a result, your 334 is a rugged and reliable instrument whose performance and design exhibit the qualities of a finely engineered laboratory instrument.*

*To fully appreciate and protect your investment, we suggest that you take a few minutes to read this manual. As always, X-Rite stands behind your 334 with a full one-year limited warranty and a dedicated service organization. If the need arises, please don't hesitate to call on us.*

*Thank you for your trust and confidence.*

*X-Rite, Incorporated*

## General Description

The X-Rite 334 is a battery operated hand-held portable sensitometer designed for quality control of cine and x-ray processing systems. Advanced low power circuitry allows a long battery service life without sacrificing performance. Replacement batteries are the 9V alkaline type.

The sensitometer produces a repeatable stepped exposure on applicable film. This is done by exposing a piece of film in the sensitometer, processing it, and comparing it with a reference film prepared when processing conditions were known to be satisfactory.

Sensitometry information will enable an operator to consistently maintain the upper limits of informational content in their radiographic processing, establish relative film processing quality standards within the department, and achieve total system control of quality between other x-ray departments.

The unique "calibration monitor" circuit provides repeatable exposures from month-to-month and from instrument-to-instrument. Its ease of operation enables anyone with little instruction to expose repeatable sensitometry strips with either blue or green exposing light, simulating the blue and green intensifying screens.

# 1. GETTING STARTED

## 1.1. Packaging Check List

Remove the instrument from the shipping carton. Inspect for possible damage. If any damage is noted, contact the transportation company immediately. Do nothing more until the carrier's agent has inspected the damage.

If damage is not evident, check to make sure that the following items are included:

Operation Manual (P/N 334-500)

Registration Card (complete and mail)

X-Rite 334 Sensitometer

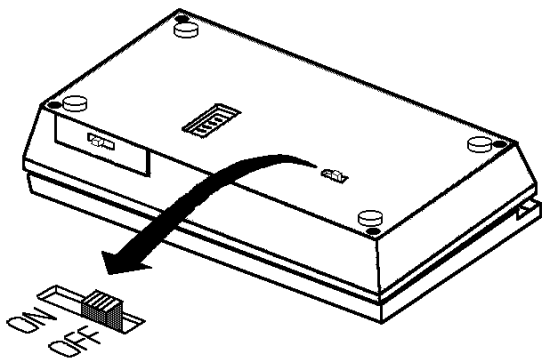
Soft Vinyl Carrying Case (P/N B318-38-01)

Certificate of Calibration

Your X-Rite 334 was packaged and shipped in a specially designed carton to assure against damage. If reshipment is necessary, the instrument should be repackaged in the original carton. If the original carton is not available, a new one can be obtained from X-Rite, Incorporated.

## 1.2. Applying Power

The unit is shipped with the power switch in the "OFF" position (power switch is located on bottom of unit). Slide the switch to the "ON" position. Because there is no current drain on the battery during nonuse periods, the power switch can remain in the ON position. The only time that the power switch must be turned OFF is when the unit is transported or the battery is replaced.



Your 334 Sensitometer is designed to operate from its battery for approximately one year. Should your 334 become inoperative, **REPLACE THE BATTERY FIRST** (see Section 3.4) If this does not rectify the problem, then refer the instrument to X-Rite or an authorized service center for proper servicing.

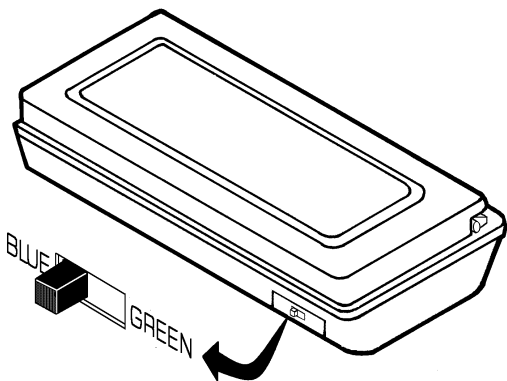


## 2. OPERATION

### 2.1. Color Selection

Optimum sensitometric control occurs when the proper color light exposes the film. Expose with the same color emitted from the intensifying screen recommended by the film manufacturer for the film being exposed. (e.g., when using blue emitting intensifying screen - expose in BLUE position.)

Slide the color switch on the front of the unit to the left for "BLUE" or to the right for "GREEN."

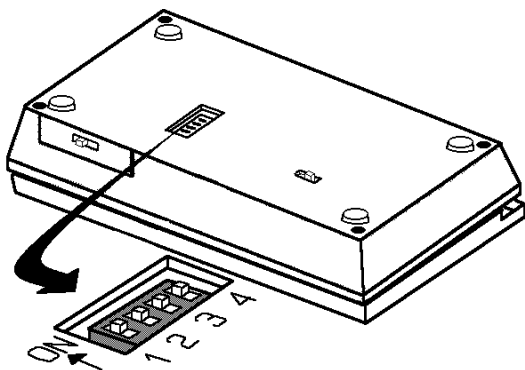


The exposure time can be set in accordance with the manufacturers requirements. See section 2.2 for exposure settings.

## 2.2. Exposure Setting

The 334 has the capability of seven separate exposure times for green. Each exposure setting will move the speed index on the exposed film approximately one step. The factory preset exposure time is #3. This setting is adjusted for general radiographic films. The high settings should be used for cine exposures. The exposure setting dip switch is located on the bottom of the unit.

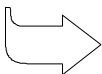
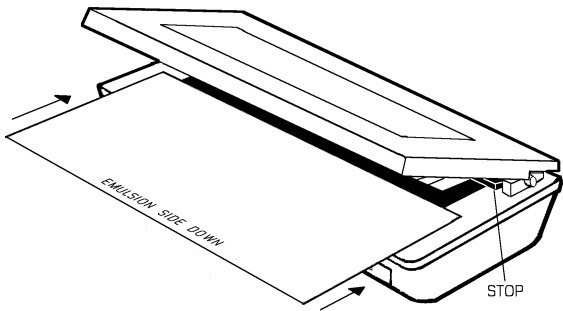
Exp. Setting	Dip Setting "ON"
#1 (Min)	None
#2	Switch 1
#3 (Normal)	Switch 2
#4	Switch 3
#5	Switches 1, 2, & 3
#6	Switch 4
#7 (Max)	Switches 3 & 4



## 2.3. Exposing Film

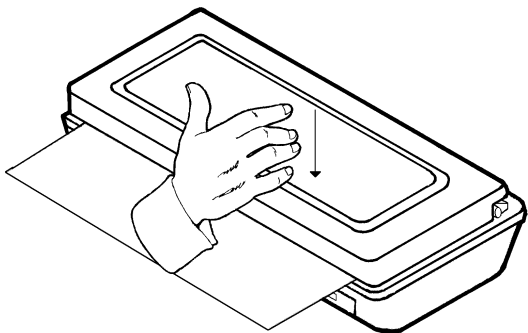
Expose the film selected as follows:

1. Select exposing color (see Section 2.1).
2. Adjust exposure setting if required (see Section 2.2).
3. Insert the film with the emulsion side down so that the back edge is against the stop.

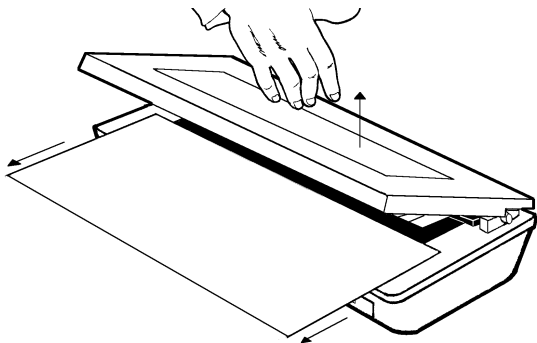


## 2.3 Exposing Film - continued

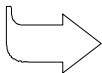
4. Press the cover down and hold firmly until the buzzer has sounded. Always press down in center of cover.



5. Allow the cover to raise and remove the film immediately.



6. Develop the film in the processor to be monitored (see Section 4).



## 2.3 Exposing Film - continued

7. Record data on the film immediately after development (See Section 4).

### IMPORTANT NOTES:

1. Small format films (5" x 7") must be centered in the instrument.
2. Film must be inserted all the way to the back of the unit in order to be exposed properly.
3. The sensitometer is calibrated to expose screen-type films normally used for general radiography to an approximate density of  $1.0D + \text{Base} + \text{Fog}$  on Step No. 11.
4. If the X-Rite 380/381 Densitometer is used to measure film strips (see Sec. 4.3.3), the sensitometric exposure must have a gamma of .7 or greater on steps 7 through 15. There must be a visible density difference between each step (density must increase by at least .11D between each of those steps).

## **3. MAINTENANCE**

### **3.1. General**

The X-Rite 334 Sensitometer is covered by a one-year limited warranty and should be referred to the factory for repair within this warranty period. Attempts to make repairs within this time frame may void the warranty.

### **3.2. Factory Repair**

X-Rite recognizes the need to provide complete technical repair service to their customers. Because of the complexity of the circuitry, all circuitry repairs should be referred to the factory or an authorized service center.

X-Rite will repair any 334 submitted past warranty. Shipping costs to the factory shall be paid by the customer and the instrument shall be submitted in its special carton as a complete unaltered unit.

### 3.3. Cleaning Step Tablet

The exposure area is protected by an acetate cover sheet. Clean this sheet periodically with lens tissue or a lint-free cloth. Dust with a camel-hair brush.

### 3.4. Battery Replacement

A low battery condition prevents exposures from occurring. **ALWAYS REPLACE THE BATTERY FIRST** before referring the unit to the factory for repairs. Replace the battery as follows:

1. Turn power OFF, and remove four screws on bottom cover.
2. Carefully lift up bottom cover and set aside.
3. Remove the 9V battery from its holder and disconnect the battery from the circuit.
4. Connect a replacement 9V alkaline battery to the circuit and insert it into holder.



**Connection of the battery leads backwards may cause circuit failure.**

5. Reinstall bottom cover in place with four screws and turn power ON.

## 4. APPLICATIONS

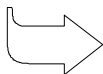
### 4.1. Sensitometer Monitoring for Processor Control

#### 4.1.1. Film Response to Exposure

The Model 334 exposes film with a known quantity of light through a 21-step light modulator. The maximum light is emitted from Step No. 21. Each successive step emits 70.7% of the light emitted from the step adjacent to it (.15 log exposure). The film exposed responds to this exposure in a predictable way called the D-Log E Curve, (i.e., Density-Log Exposure Curve). The D-Log E Curve (figure 1, page 12) shows the response of a typical radiographic film to exposure with the Model 334. The portion of the curve that changes most with variations in processing is called the "straight line portion" of the curve.

It is not necessary to plot D-Log E Curves to monitor automatic processors in normal laboratory environments. A simpler method is to record the three points on the D-Log E Curve which contain most of the data.

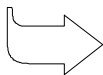
The following three points on the curve should be monitored to give pertinent processing data.





#### 4.1.1 Film Response to Exposure - cont.

1. **Base+Fog**: Step No. 1 on the D-Log E Curve is called Base+Fog the least exposed portion of the film. It is the base support density plus any silver emulsion density developed in the area where negligible exposure should occur.
2. **Speed Index**: The step on the exposed film with a density nearest  $1.0D + \text{Base+Fog}$  is called Speed Index. This step is a direct indicator of film speed. Variations in processor conditions are monitored on this step.
3. **Contrast Index**: The slope of the straight-line portion of the D-Log E Curve is called Contrast Index. Select the step closest to but not larger than  $2.20D$ . Subtract from this step the step closest to but not lower than  $0.45D$ . Contrast Index is used to monitor processor variations in conjunction with the Speed Index.



## 4.1.1 Film Response to Exposure - cont.

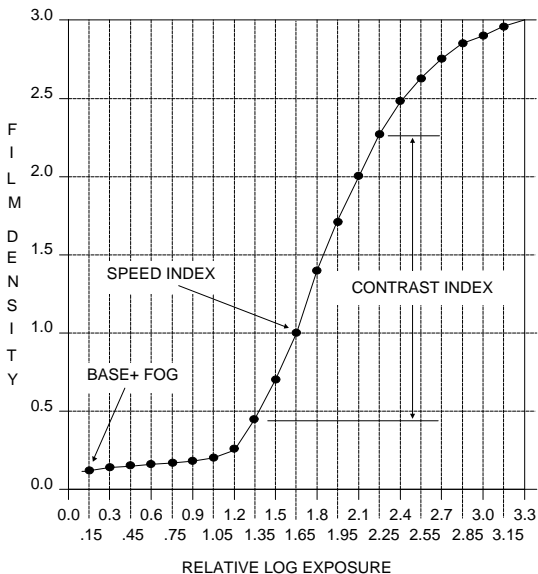


Figure 1. D-Log E Curve

### **4.1.2. Selection and Use of Film**

The film selected to monitor a given processor should be representative of the film used with that processor.

### **4.1.3. Scheduling Sensitometric Control**

Every processor in use should have a separate control chart plotted to monitor its behavior. The more frequent the data points, the better the control feedback. A control film should be run at start-up of the processor and at least once a day. Use sensitometry whenever trouble is suspected, or a change has been made to the process.

## 4.2. Processing Procedure

1. Allow the processor temperature and chemistry to reach equilibrium when starting up the processor before processing film.
2. Run a full width film for cleanup at start-up.
3. Orient the film into the processor in a consistent manner - making sure the emulsion side is inserted per processor manufacturer's specification.
4. After processing of the film is complete, record the date, time, and processor identification number on the film in the designated areas.

<b>X-Rite</b>	
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<input type="text"/>	<b>3</b>
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## 4.3. Data Recording Procedure

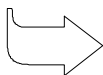
### 4.3.1. Establishing Normal Speed Index, Contrast Index, and Base+Fog

The normal speed index, contrast index, and base+fog values are established on a representative film, when the processor is considered to be operating in an optimum fashion.

Run several film samples and determine the average values for, speed index, contrast index, and base+fog, using a transmission densitometer. Step wedge areas are as uniform as is possible to produce. There are, however, some errors at the edges of the step area. Therefore, always measure density at the center of the step. Use a 2mm aperture to give best repeatability.

Record the following data on the process control record (available from X-Rite, P/N 306-00):

Developer Temperature:	Temperature of developer solution in processor during processing.
Normal Speed Index:	The density of the step closest to 1.0D + base+fog. The step number should remain the same for a given process and film type.



### 4.3.1 Establishing Normal, Speed Index, Contrast Index, and Base+Fog - cont.

Normal Contrast Index: Select the step closest to but not larger than 2.20D. Subtract from this step the step closest to but not lower than 0.45D.



Monitor subsequent films on the same step numbers selected for normal speed index and normal contrast index.

Normal Base+Fog: Step No. 1 density, the least exposed step on the wedge.

Date: Month-Day-Year

Processor No: Processor ID.

Emulsion No: Film batch ID.

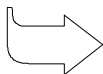
Developer Type: Developer vendor ID.

Fixer Type: Fixer vendor ID.

Film Type: Film vendor ID.

Exposure Color: Exposure light (blue or green).

Developer Replenishment: The rate of developer replenishment.



### 4.3.1 Establishing Normal, Speed Index, Contrast Index, and Base+Fog - cont.

Fixer Replenishment: The rate of fixer replenishment.

Processor Time: Film processor time, input-to-output.

A box of film should be set aside from regular stock for exclusive sensitometer use. New film stock will require reestablishment, because small density changes are possible between film batches.

### 4.3.2. Daily Plotting of Data on Process Control Record

Plot the results on the control record each time a control film is developed. Record data immediately so that it is not lost or changed. The following processor data will be plotted.

Use the same step numbers selected for



normal speed index and normal contrast index.

- Speed Index
- Contrast Index
- Base+Fog
- Developer Temperature

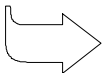
### **4.3.3. Using the 381 Densitometer to Measure and Record Film Data**

When the 381 densitometer is used to measure process film, it will automatically calculate and store the values for, speed index, contrast index, and base+fog. The unit will also store up to 32 measurements of film data. And, when interfaced with a printer, it will print-out the process control record.

### **4.4. Processor Troubleshooting**

When troubleshooting out-of-tolerance processor conditions, use Speed Index as the primary guide. Speed Index is the most predictable indicator for all film types. Base+Fog is predictable, but is the least sensitive. Contrast Index reacts predictably for a given set of film conditions but may vary from film to film.

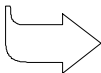
Listed on the next page is a chart showing Speed Index and Base+Fog reactions to common processor problem conditions.





## 4.4 Processor Troubleshooting - cont.

Speed Index	Base+Fog	Possible Cause
High	High or Normal	Developer temp too high. Developer over replenished. Processor cycle time too slow. Improper safe lighting. Improper solution mix.
Low	Low or Normal	Developer temp too low. Developer under replenished. Contaminated developer. Inadequate developer circulation. Improper solution mix. Processor cycle time too fast.



## 4.4 Processor Troubleshooting - cont.

As Control Records become more complete for a given film, the relationships between Contrast Index and Processor Conditions will become apparent. Always note the reason for out-of-tolerance processor condition - on the Control Record (P/N 306-00).



When out-of-tolerance conditions are noticed, always verify readings with another test film.

## **5. APPENDIX**

### **5.1. Proprietary Notice**

The information contained in this manual is derived from patent and proprietary data from X-Rite, Incorporated. This manual has been prepared solely for the purpose of assisting operation and maintenance personnel in their use of the X-Rite 334.

Publication of this information does not imply any rights to reproduce it or use it for any purpose other than installing, operating, or maintaining the equipment described herein.

No part of this manual may be reproduced, transcribed, transmitted, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, electronic, magnetic, mechanical, optical, manual, or otherwise, without the prior written permission of an authorized officer of X-Rite, Incorporated.

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"ALL RIGHTS RESERVED"

## 5.2. Limited Warranty

X-Rite, Incorporated warrants each instrument manufactured by them to be free of defects in material and workmanship for a period of 12 months. THERE ARE NO WARRANTIES OF MERCHANTABILITY OR FITNESS. THIS WARRANTY OBLIGATION IS LIMITED TO SERVICING THE UNIT RETURNED TO THE FACTORY FOR THAT PURPOSE AND EXCLUDES THE BATTERY. The instrument shall be returned with transportation charges prepaid. If the fault has been caused by misuse or abnormal conditions of operations, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

An Instrument Registration Card is enclosed with each instrument. The purchaser should fill in the card completely and return it to X-Rite, Incorporated postmarked no later than ten days from the date of receipt. This card registers your instrument with us for warranty coverage. Once your instrument is registered, we are able to maintain a file to help expedite service in case it is needed. Always include serial number and place of purchase in any correspondence concerning your instrument. The serial number is located on the bottom of the instrument.

X-Rite, Incorporated offers a repair program for instruments out of warranty. For more information, contact X-Rite Instrument Services Department.

This agreement shall be interpreted in accordance with the laws of the State of Michigan and jurisdiction and venue shall lie with the courts of Michigan as selected by X-Rite, Incorporated.

### 5.3. Specifications

Design Conformance:	A.N.S.I. PH2.9 - 1974*
Unit to Unit Repeatability:	$\pm.04$ Log Exposure
Exposure Stability:	$\pm.02$ Log Exposure per year
Temperature Sensitivity:	$\pm.02$ Log Exposure from 59°F (15°C) to 86°F (30°C)
Electrical Requirement:	9V Alkaline battery
Light Modulation:	21-Step Wedge, 0.15D per step
Blue Color Peak Wavelength:	460nm $\pm$ 10nm
Green Color Peak Wavelength:	510nm $\pm$ 10nm
Warm-up Time:	Instantaneous
Size:	3.0"W x 7.0"D x 1.5"H
Weight:	1.25 lbs. (.57Kg)

\*American National Standards Institute compliance except as noted.



X-Rite, Incorporated - World Headquarters  
3100 44th Street S.W. • Grandville, Michigan 49418 • USA  
[www.x-rite.com](http://www.x-rite.com) • (616) 534-7663

Toll-Free U.S. Numbers

Tel: 1-888-826-3044 • Fax: 1-888-826-3045

Toll-Free International Numbers

Tel: 1-888-826-3039 • Fax: 1-888-826-3041

X-Rite GmbH

Stollwerckstraße 32 • 51149 Köln • Germany

Tel: (49) 2203-91450 • Fax: (49) 2203-914519

X-Rite GmbH

Sochorova 705 • CZ-682 • 11 Vyskov • Czech Republic

Tel: (420) 507-328197 • Fax: (420) 507-328138

X-Rite Asia Pacific Ltd.

Room 808-10 • Kornhill Metro Tower • 1 Kornhill Road • Quarry Bay

Hong Kong • Tel: (852) 2-568-6283 • Fax: (852) 2-885-8610

X-Rite Ltd.

The Acumen Centre • First Avenue

Poynton, Cheshire • England

Tel: 44-0-1625-871100 • Fax: 44-0-1625-871444

X-Rite Méditerranée

Parc du moulin de Massy • 35, rue du Saule Trapu • 91300 Massy • France

Tel: 33-1-69.53.66.20 • FAX 33-1-69.53.00.52

X-Rite Asia Pacific Ltd. - Japan Office

Suite 506 AIOS Gotanda • 1-7-11 Higashi-Gotanda

Shinagawa-ku, Tokyo • 141-0022 Japan

Tel: 81-3-5447-1607 • Fax: 81-3-5447-1608