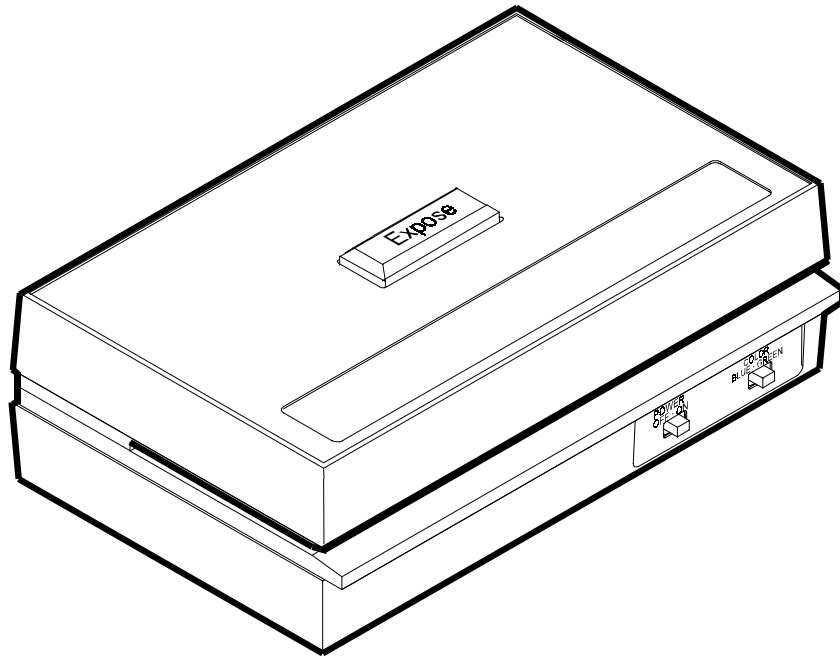


383

SINGLE-SIDED EXPOSURE PROCESS CONTROL SENSITOMETER



Operator's Manual



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.

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: Un raccordement inversé des piles peut endommager le circuit. Utiliser seulement des piles fer-nickel de 9 volts.

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

SPECIFICATIONS

Design conformance	A.N.S.I. PH2.9-1974*
Unit to Unit Repeatability	±.02 Log Exposure
Exposure Stability	±.02 Log Exposure per year
Temperature Sensitivity	±.02 Log Exposure from 59°-86°F
Electrical Requirement	9V Alkaline battery
Light Modulation	21-Step Wedge, 0.15D per step
Blue Color Peak Wavelength	460nm ±.10nm
Green Color Peak Wavelength	510nm ±.10nm
Warm-up Time	Instantaneous
Recycle Time	2 Seconds
Size	8.5"W x 5.25"D x 3.0"H
Weight	2 1/2 lbs.

*American National Standards Institute compliance except as noted.

CE DECLARATION

Manufacturer's Name: X-Rite, Incorporated
Manufacturer's Address: 3100 44th Street, S.W.
Grandville, Michigan 49418
U.S.A.

Model Name: Sensitometer
Model No.: 383

Directive(s) Conformance: EMC 89/336/EEC

Dear Customer,

Congratulations! We at X-Rite, Incorporated are proud to present you with the X-Rite 383 Sensitometer. This instrument represents the very latest in low power integrated circuit design. As a result, your 383 is a rugged and reliable instrument whose performance and design exhibit the qualities of a finely engineered instrument, which is not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. As always, X-Rite stands behind your 383 with a full one-year limited warranty and a dedicated service organization. If the need arises, please don't hesitate to call us.

Thank you for your trust and confidence.

X-Rite, Incorporated

GENERAL DESCRIPTION

The 383 Sensitometer is a battery operated, dual color, single sided exposure sensitometer designed for quality control of cine and x-ray processing systems.

Advanced low power circuitry allows a long battery life without sacrificing performance. Replacement batteries are 9V alkaline type. The 383 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 operators 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 of the unit 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 light from blue and green intensifying screens.

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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 and general maintenance of the X-Rite 383.

The contents of this manual are the property of X-Rite, Incorporated and are copyrighted. Any reproduction in whole or part is strictly prohibited. Publication of this information does not imply any rights to reproduce 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, in any form or by any means--electronic, magnetic, mechanical, optical, manual, or otherwise--without prior written permission of an authorized officer of X-Rite, Incorporated.

This instrument is covered by the following U.S. and foreign patents:
U. S. patent #4,235,537 and other patents pending.

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 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 operating conditions, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

A Warranty Registration Card is enclosed with each instrument. The purchaser should fill in the warranty registration card completely and return it to X-Rite, Incorporated postmarked no later than ten (10) days from the date of receipt. This card registers your system with us for warranty coverage. Once your unit 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 Technical 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.

TABLE OF CONTENTS

Specifications	i
Opening Letter	iii
General Description	iii
Proprietary Notice	iv
Warranty	iv
Getting Started	1
Packaging Check List	1
Applying Power	1
Operation	2
Color Selection	2
Exposure Setting	2
Exposing Film	3
Maintenance	5
General	5
Factory Repair	5
Cleaning Step Tablet	5
Battery Replacement	6
Applications	7
Sensitometer Monitoring for Processor Control	7
Film Response to Exposure	7
Selection and Use of Film	8
Scheduling Sensitometric Control	8
Processing Procedure	8
Data Recording Procedure	9
Establishing Normal Speed Index, Contrast Index, and Base + Fog	9
Daily Plotting of Data on Processor Control Record	10
Using the X-Rite 381 Densitometer to Measure and Record Film Data	10
Processor Troubleshooting	11

GETTING STARTED

PACKAGING CHECK LIST

Remove the instrument from the shipping carton, and 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:

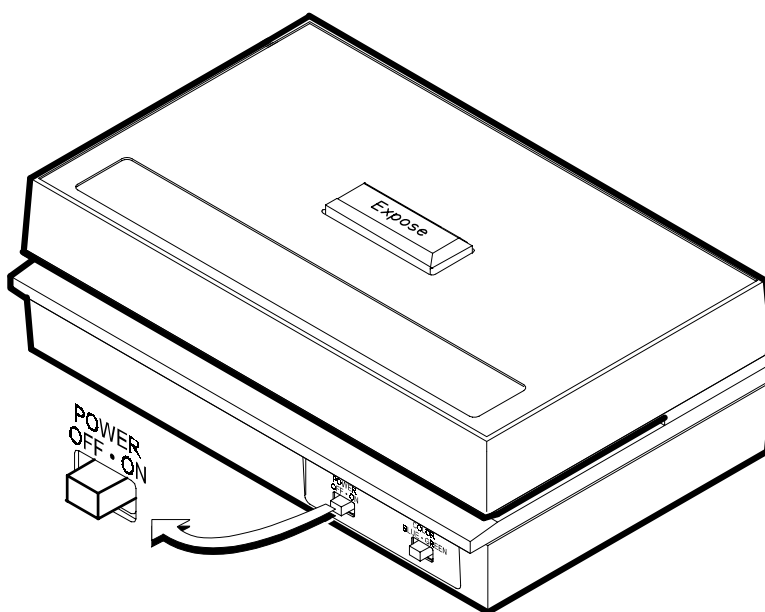
- Important Notice
- Registration Card
- Operation Manual
- Sensitometer

Your sensitometer 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.

APPLYING POWER

The sensitometer is shipped with the battery installed and the power switch in the OFF position. 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 sensitometer is designed to operate from its 9V alkaline battery for approximately one year. When the battery is low the circuit will not allow any exposures to occur. Should your unit become inoperative, **REPLACE THE BATTERY FIRST** (see Factory Repair). If this does not rectify the problem, then refer the instrument to X-Rite or an authorized service center for proper servicing. There are no user serviceable components in the sensitometer.



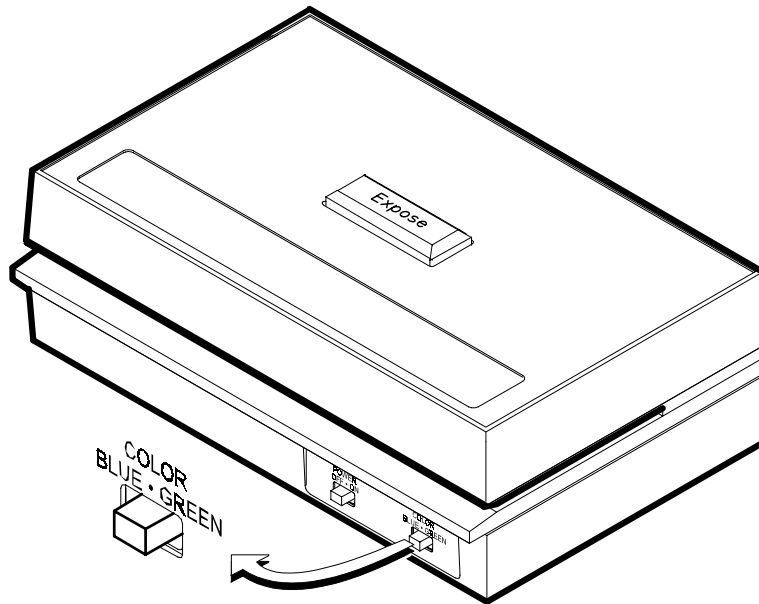
OPERATION

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.

For example, 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.

NOTE: The exposure time should be set in accordance with the manufacturer's requirements. See the next section (Exposure Setting) for detail on exposure settings.



EXPOSURE SETTING

The sensitometer has the capability of seven different exposure times for both blue and green. The factory preset exposure setting is #3. If different exposure times are required, refer to the chart below (or bottom of unit) for the settings. Each exposure setting will move the speed index on the film one step.

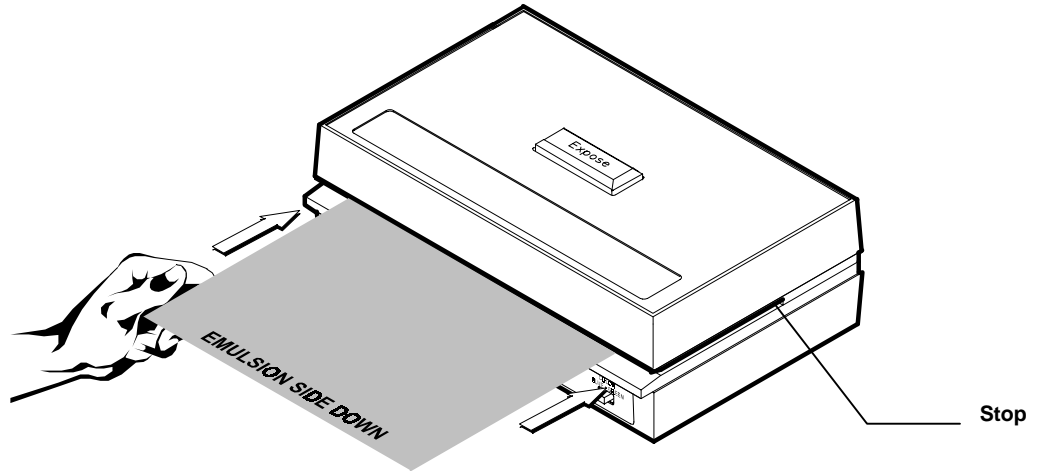
The DIP SWITCH used to change the exposure time is located on the bottom of the unit. When the blue color is selected, switches A, B, C, D--bracketed as blue--are activated. When the green color is selected, switches A, B, C, D--bracketed as green--are activated.

EXP. SETTING	DIP SWITCH SETTING			
	A	B	C	D
#1 (Min)	OFF	OFF	OFF	OFF
#2	ON	OFF	OFF	OFF
#3 (Normal)	OFF	ON	OFF	OFF
#4	OFF	OFF	ON	OFF
#5	ON	ON	ON	OFF
#6	OFF	OFF	OFF	ON
#7 (Max)	OFF	OFF	ON	ON

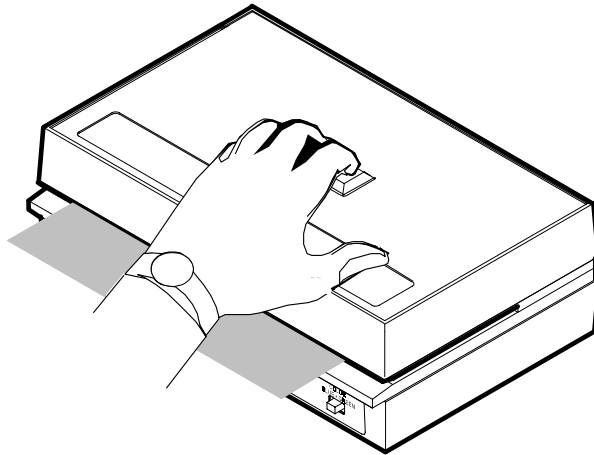
EXPOSING FILM

Expose the film selected as follows:

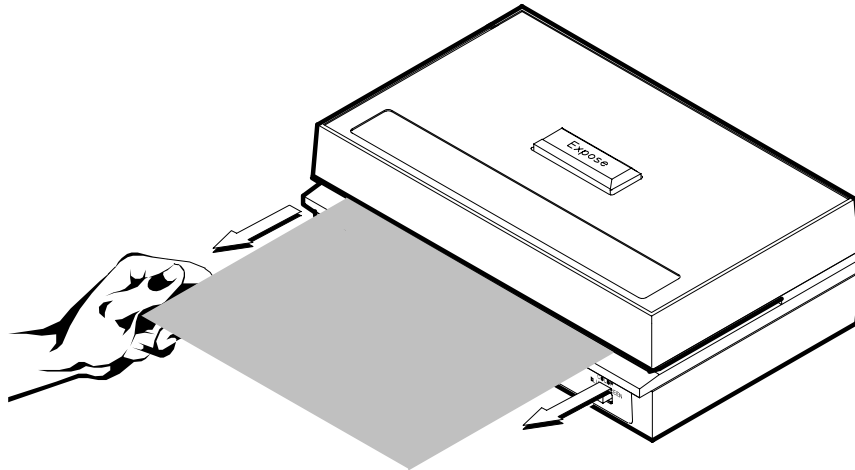
1. Select exposing color (see Color Selection).
2. Adjust exposure setting if required (see Exposure Setting).
3. Insert the film emulsion-side down with the back edge against the stop, and the film centered in the unit.



4. Press the EXPOSE button down and hold until the buzzer has sounded. Always press straight down with even pressure across the EXPOSE button.



5. Release the EXPOSE button and remove the film immediately.



6. Develop the film in the processor to be monitored (see Applications).
7. Record data on the film immediately after development (see Applications).

IMPORTANT NOTES

1. Film must be inserted all the way to the back of the unit in order to be exposed properly.
2. 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.
3. If the X-Rite 380 or 381 Densitometer is used to measure film strips (see Using the X-Rite Densitometer to Measure and Record Film Data), the sensitometric exposure must meet the following criteria:
 - The exposure must have a gamma of .7 or greater on steps 7 through 15. There must be a visibility density difference between each step (density increments of at least .11D).
 - The film must have at least 1.1” of clear leader at both ends of the exposure. The use of 8” x 10” or 18cm x 24cm film is recommended.

MAINTENANCE

GENERAL

The X-Rite 383 is covered by a one-year limited warranty (excluding battery) and should be referred to the factory or authorized service center for repairs within the warranty period. Attempts to make repairs within this time frame may void the warranty.

FACTORY REPAIR

X-Rite provides a factory repair service to their customers. Because of the complexity of the circuitry all circuit repairs should be referred to the factory or an authorized service center. X-Rite will repair any 383 past warranty.

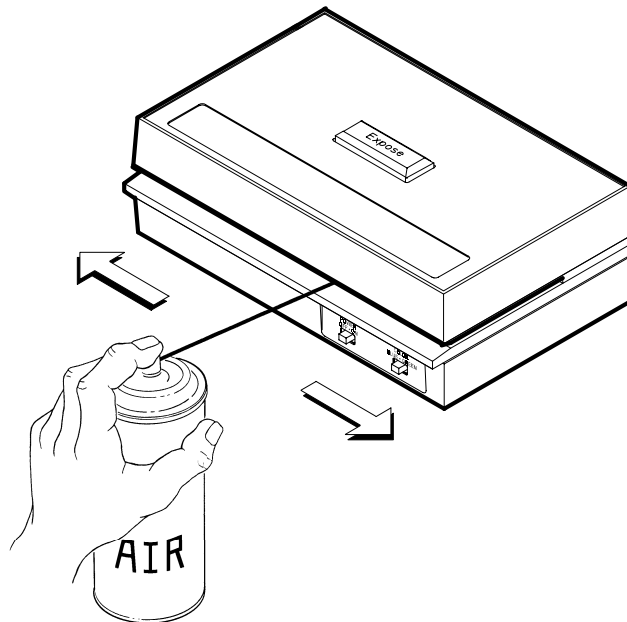
Shipping costs to the factory or an authorized service center shall be paid by the customer and the instrument shall be submitted in its original carton, as a complete unaltered unit.

A 383/384 Subassembly Troubleshooting Manual is available from X-Rite: order P/N 383-505.

CLEANING STEP TABLET

To remove any dust and lint from the exposure area, follow the procedure below periodically.

1. Holding container of canned air upright, insert tube from the container into the exposure slot. Make sure the air is clean and free of moisture.
2. With back and forth motion, spray air into exposure slot from one end to the other. Repeat several times. This should remove any dust and lint that may have collected.



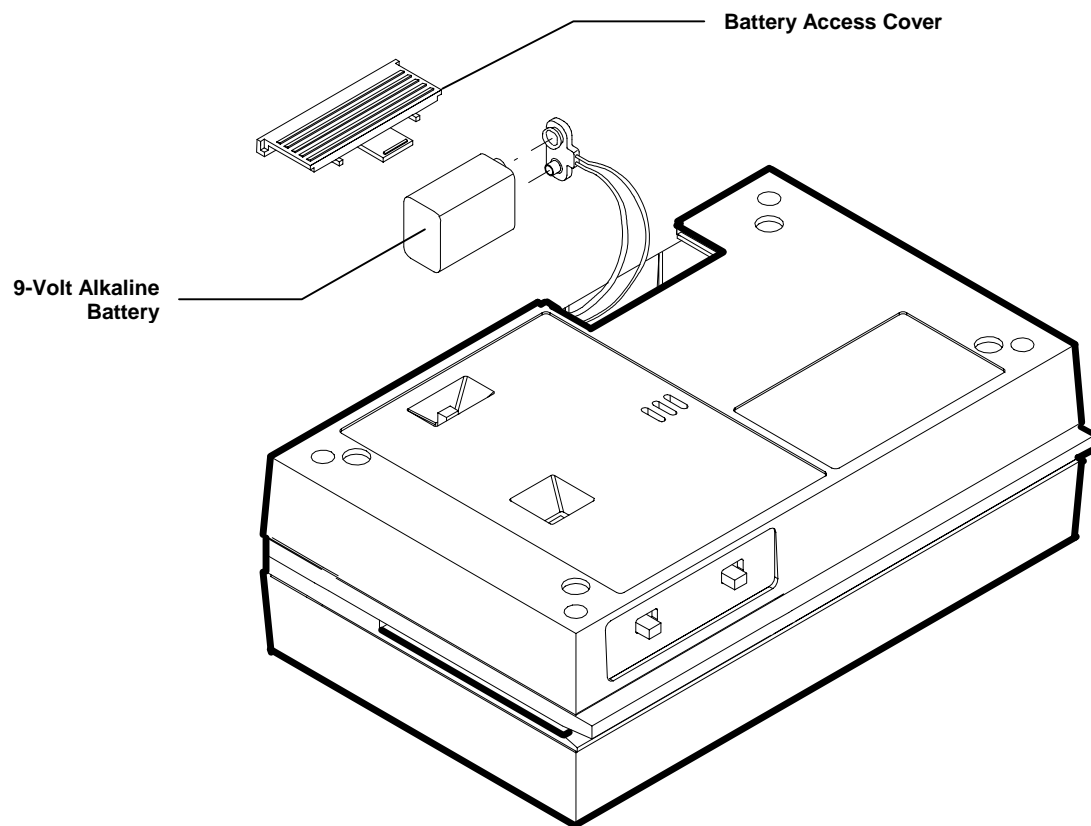
BATTERY REPLACEMENT

Replace the battery as follows:

1. **Turn power OFF** and remove battery access cover on bottom of unit by sliding outward.
2. Disconnect old 9V battery from the circuit and discard.
3. Connect a replacement 9V **alkaline** battery to the circuit and insert it into the battery compartment.

CAUTION: Connecting the battery leads backward may cause circuit failure.

4. Reinstall the battery access cover and turn power ON.



APPLICATIONS

SENSITOMETER MONITORING FOR PROCESSOR CONTROL

FILM RESPONSE TO EXPOSURE

The sensitometer 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 (Density-Log Exposure Curve). The figure below shows the response of a typical radiographic film to exposure with the sensitometer. 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.

Sufficient processing data can be obtained from monitoring the following three points:

1. Base + Fog

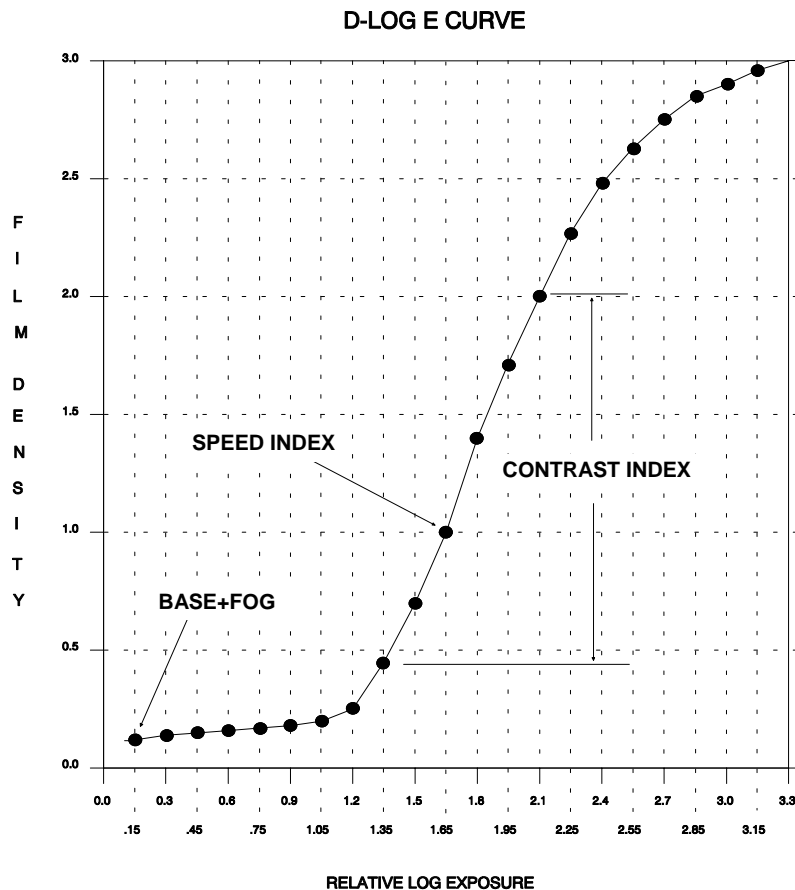
Step No. 1 on the D-Log E Curve. This is the least exposed portion of the film. It is the base support density plus any silver emulsion density developed in the area where negligible exposure should occur.

2. Speed Index

The step on the exposed film with a density nearest $1.0D + \text{Base} + \text{Fog}$. 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. Select the step closest to, but not lower than, $0.45D$. Contrast Index is used to monitor processor variations in conjunction with the Speed Index.



SELECTION AND USE OF FILM

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

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.

PROCESSING PROCEDURE

1. Allow the processor temperature and chemistry to reach equilibrium when starting up the processor before processing film.
2. Films should be processed immediately after being exposed. Any delay between exposure and processing should be consistent from film to film.
3. Run a full width film for cleanup at start-up.
4. Orient the film into the processor in a consistent manner—making sure the film is inserted per processor manufacturer’s specification.
5. After processing of film is complete, record the date, time, and processor identification number on the film in the designated areas.

X-Rite	
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HERE

DATA RECORDING PROCEDURE

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 Base + Fog	Step number one density, the least exposed step on the wedge
Normal Speed Index	The density of the step exposed and developed closest to $1.0D + \text{Base} + \text{Fog}$. The step number should remain the same for a given process and film type.
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 $0.45D$. NOTE: Monitor subsequent films on the same steps selected for normal contrast index.
Date	Month – Day – Year
Processor Number	Processor identification
Emulsion Number	Film batch identification
Developer Type	Developer vendor identification
Fixer Type	Fixer vendor identification
Film Type	Film vendor identification
Exposure Color	Exposure light (blue or green)
Developer Replenisher Rate	The rate of developer replenishment
Fixer Replenisher Rate	The rate of fixer replenishment
Processing Time	Film process 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 of normal values because small density changes are possible between film batches.

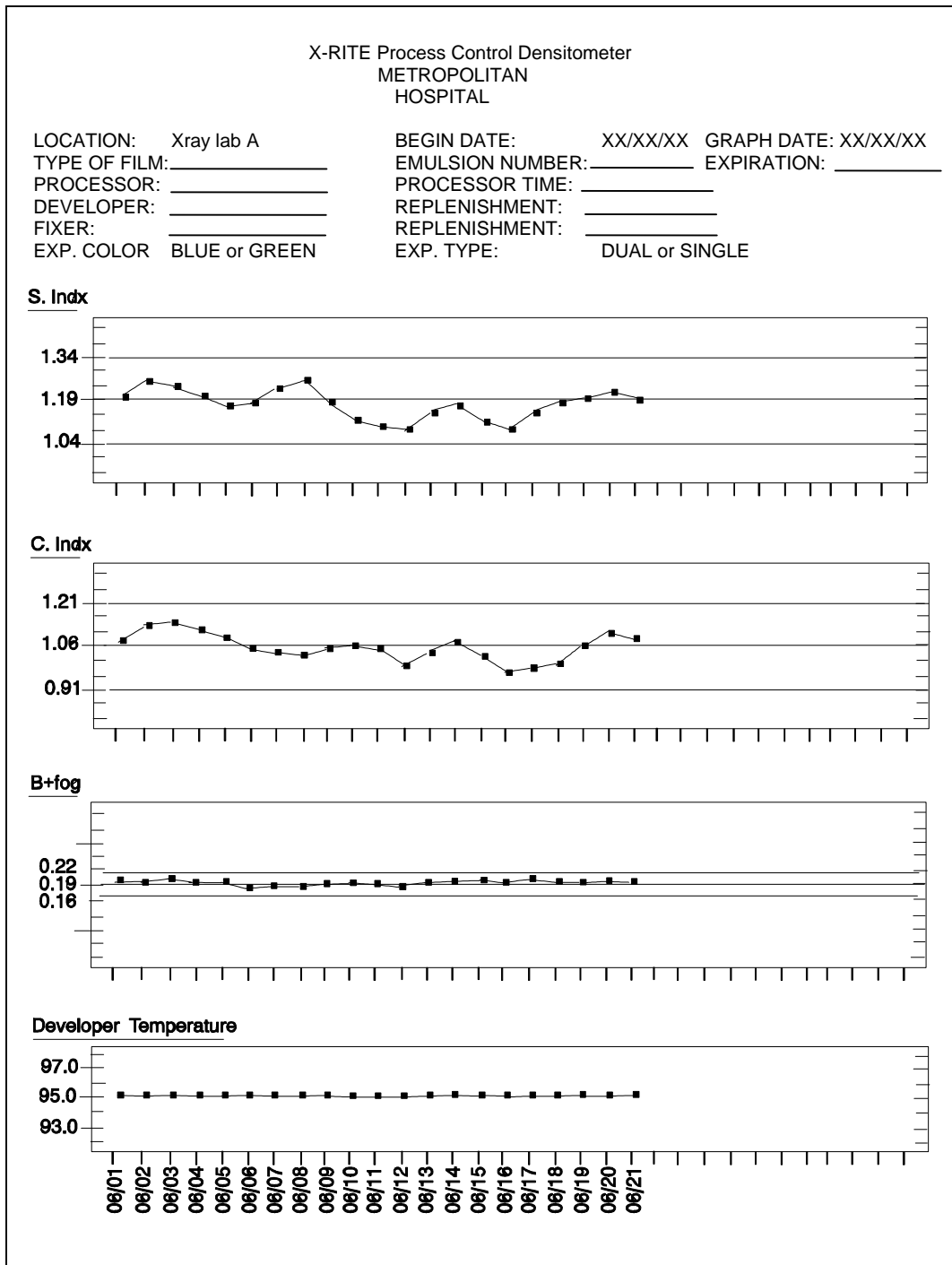
DAILY PLOTTING OF DATA ON PROCESS CONTROL RECORD

Plot the results on the process 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:

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

USING THE X-RITE 381 DENSITOMETER TO MEASURE AND RECORD FILM DATA

When the X-Rite 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, will print out the process control record. The example below shows a sample process control record printed by the densitometer.



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.

The following chart shows Speed Index and Base + Fog reactions to common processor problem conditions.

SPEED INDEX	BASE + FOG	POSSIBLE CAUSE
High	High or Normal	Developer temperature too high Developer over replenished Improper safe lighting Improper solution mix
Low	Low or Normal	Developer temperature too low Developer under replenished Contaminated developer Inadequate developer circulation Improper solution mix

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 conditions**—preferably on the Control Record.

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



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