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ABSTRACT

This workbook has been designed for use in conjunction with the manual, "Photographic Quality Assurance in Diagnostic Radiology, Nuclear Medicine and Radiation Therapy." Presented are several typical problems arising from the existence of variability and fluctuations in the automatic processing of radiographs, which unless corrected, can contribute significantly to increased patient dose, increased incidences of retakes, and poorer image quality. Each problem is presented as an exercise followed by a step-by-step reasoning process, so that the probable cause and appropriate corrective measures can be determined. (CS)

SE

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Radiographic Film Processing Quality Assurance: A Self-Teaching Workbook

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Food and Drug Administration

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FDA 79-8086 Evaluation of Commercially Available Laser Protective Eyewear (PB 80-103039, $9.00).

FDA 79-8087 X rays, Pregnancy and You...(brochure).

FDA 79-8088 X Rays: Get the Picture on Protection (brochure).

FDA 79-8088S Sepa Co no Protegerse de los Rayos Equis (brochure).

FDA 79-8090 Source Book of Educational Materials for Radiation Therapy (GPO 017-015-00159-8, $4.50) (PB 299 415/AS, mf only).

FDA 79-8093 Guide for the Preparation of Cathode Ray Tube Reports Pursuant to 1002.10 and 1002.12.

FDA 79-8094 Quality Assurance for Radiographic X-Ray Units and Associated Equipment (PB80-101 405, $9.00).

FDA 79-8097 Analysis of Retakes: Understanding, Managing, and Using an Analysis of Retakes Program for Quality Assurance (PB 80-102445, $6.00).

FDA 79-8098 Bureau of Radiological Health Index to Selected Acoustic and Related References (PB 80-120967, $20.00).

FDA 80-8024 FDA X-Ray Record Card (card).

FDA 80-8027 Directory of Personnel Responsible for Radiological Health Programs (supersedes FDA 80-8027, September 1979).

FDA 80-8034 Report of State and Local Radiological Health Programs, Fiscal Year 1978 (PB 80-130867, $6.00).

FDA 80-8035 Regulations for the Administration and Enforcement of The Radiation Control for Health and Safety Act of 1968 (July 1980) (GPO 017-015-00173-3, $3.75) (supersedes FDA 79-8035).

FDA 80-8057 Nationwide Evaluation of X-Ray Trends: Dental X-Ray Data (brochure) (supersedes FDA 78-8057).

HHS Publication FDA 81-8146

quality assurance series

Radiographic Film Processing Quality Assurance: A Self-Teaching Workbook

Lee W. Goldman
Division of Training and Medical Applications

BRH
bureau of radiological health

WHO Collaborating Center for Training and General Tasks in Radiation Medicine

January 1981

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Food and Drug Administration
Bureau of Radiological Health
Rockville, Maryland 20857

FOREWORD

The Bureau of Radiological Health develops and carries out a national program to control unnecessary human exposure to potentially hazardous ionizing and nonionizing radiations and to ensure the safe, efficacious use of such radiations. The Bureau publishes the results of its work in scientific journals and in its own technical reports.

These reports provide a mechanism for disseminating results of Bureau and contractor projects. They are distributed to Federal, State, and local governments; industry; hospitals; the medical profession; educators; researchers; libraries; professional and trade organizations; the press; and others. The reports are sold by the Government Printing Office and/or the National Technical Information Service.

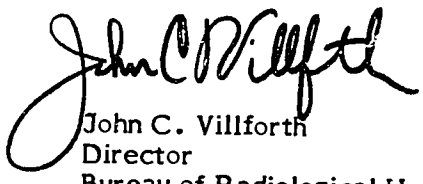
The Bureau also makes its technical reports available to the World Health Organization. Under a memorandum of agreement between WHO and the Department of Health and Human Services, three WHO Collaborating Centers have been established within the Bureau of Radiological Health, FDA:

WHO Collaborating Center for Standardization of Protection Against Nonionizing Radiations;

WHO Collaborating Center for Training and General Tasks in Radiation Medicine; and

WHO Collaborating Center for Nuclear Medicine.

Please report errors or omissions to the Bureau. Your comments and requests for further information are also encouraged.



John C. Villforth
Director
Bureau of Radiological Health

PREFACE

Production of radiologic images of acceptable diagnostic quality obtained with minimum radiation exposure to patients is a basic goal of the Bureau of Radiological Health (BRH). The efforts of the Division of Training and Medical Applications to meet this goal are diverse; one very promising approach is the development and dissemination of Quality Assurance (QA) informaton and methodology for medical uses of radiation. A Quality Assurance Recommendation for diagnostic radiology facilities was published in the FEDERAL REGISTER on December 11, 1979. The Division is also developing a series of quality assurance instruction manuals. These manuals describe in detail the establishment and operation of specific elements of a quality assurance program. They present proven QA techniques that can be adapted by individual radiology facilities according to their needs and resources. These manuals are part of the "BRH Quality Assurance Publications" series providing QA information for many uses of medical radiation including ultrasound, nuclear medicine, and radiation therapy as well as diagnostic radiology. A listing of subjects and specific titles follows.

This volume, "Radiographic Film Processing Quality Assurance: A Self-Teaching Workbook," is intended as an educational aid in implementing a quality assurance program for radiographic film processing. It consists of several typical examples of processing problems, each in the form of an "exercise." The exercises are presented as they would occur in practice from control charts and maintenance logs, followed by logical solutions.

This and related materials will allow a radiographic film processing QA program to be implemented with maximum ease and understanding.

We welcome comments on your experience with this manual, as well as suggestions for the content, style, and direction of future manuals.

William S. Properzio, Ph.D.
Director
Division of Training and
Medical Applications
Bureau of Radiological Health

BRH QUALITY ASSURANCE PUBLICATIONS

GENERAL

Gray, J.E. Photographic Quality Assurance in Diagnostic Radiology, Nuclear Medicine, and Radiation Therapy, Volume 1: The Basic Principles of Daily Photographic Quality Assurance. HEW Publication (FDA) 76-8043 (June 1976).

Gray, J.E. Photographic Quality Assurance in Diagnostic Radiology, Nuclear Medicine, and Radiation Therapy, Volume 2: Photographic Processing Quality Assurance and the Evaluation of Photographic Materials. HEW Publication (FDA) 77-8018 (March 1977).

U.S. Department of Health, Education, and Welfare. Quality Assurance Catalog and Quality Assurance Catalog Supplement. HEW Publication (FDA) 77-8028 (July 1977), HEW Publication (FDA) 78-8028 (August 1978). Compiled by R.L. Burkhart.

Goldman, L.W. Radiographic Film Processing Quality Assurance: A Self-Teaching Workbook. HHS Publication (FDA) 76-8146 (January 1981).

DIAGNOSTIC RADIOLOGY

Hendee, W.R. and R.P. Rossi. Quality Assurance for Radiographic X-Ray Units and Associated Equipment. HEW Publication (FDA) 79-8094 (August 1979).

Hendee, W.R. and R.P. Rossi. Quality Assurance for Fluoroscopic X-Ray Units and Associated Equipment. HEW Publication (FDA) 80-8095 (October 1979).

Hendee, W.R. and R.P. Rossi. Quality Assurance for Conventional Tomographic X-Ray Units. HEW Publication (FDA) 80-8096 (October 1979).

Goldman, L.W. and S. Beech. Analysis of Retakes: Understanding, Managing and Using an Analysis of Retakes Program for Quality Assurance. HEW Publication (FDA) 79-8097 (August 1979).

ULTRASOUND

Lopez, H. and S.W. Smith. Implementation of a Quality Assurance Program for Ultrasound B-scanners. HEW publication (FDA) 80-8100 (October 1979).

NUCLEAR MEDICINE

U.S. Department of Health, Education, and Welfare. Quality Control for Scintillation Cameras. HEW Publication (FDA) 76-8046 (June 1976).

U.S. Department of Health, Education, and Welfare. Workshop Manual for Quality Control of Scintillation Cameras in Nuclear Medicine. HEW Publication (FDA) 76-8039 (May 1976).

Hine, G., P. Paras, and C. Warr. Measurements of the Performance Parameters of Gamma Cameras, Part 1. HEW Publication (FDA) 78-8049 (December 1977).

Hine, G. et al. Measurements of the Performance Parameters of Gamma Cameras, Part II. HEW Publication (FDA) 79-8049 (June 1979).

Radionuclide Handling and Radiopharmaceutical Quality Control (to be published).

DENTAL RADIOGRAPHY

U.S. Department of Health, Education, and Welfare. Exposure and Processing Guide for Dental Radiography. HEW Publication (FDA) 77-8039 (August 1977).

CONTENTS

RADIOGRAPHIC FILM PROCESSING QUALITY ASSURANCE: A SELF-TEACHING WORKBOOK

INTRODUCTION

The existence of variability and fluctuations in the automatic processing of radiographs can contribute significantly to increased patient dose, increased incidences of retakes, and poorer image quality. A processing Quality Assurance program can eliminate and control much of this variability and be highly cost effective.

Perhaps the most difficult task in the proper maintenance of a QA program is in determining the probable cause of a processing problem, appropriate corrective action to take, and when to act. This workbook presents several typical problems requiring correction which will be found in a QA program. Each problem is presented as an exercise followed by a step-by-step reasoning process, so that you can determine the probable cause and appropriate corrective measures. In each case, these determinations are based on routinely obtained sensitometric data, simple physical measurements, consideration of the processor's recent "history," and common sense observations on the state of the processor itself. The "answers" arrived at in this way will normally represent the most likely alternative. The suggested corrective actions will not necessarily be the only ones acceptable, but are those which the author has found to be useful and workable in practice.

This workbook has been designed for use in conjunction with the manual, "Photographic Quality Assurance in Diagnostic Radiology, Nuclear Medicine and Radiation Therapy" (1). As a prerequisite, you should read it before proceeding. The slide-tape package, "A Basic Program: Quality Control for the Automatic Film Processor" (2) will provide a basic introduction to the subject of radiographic film processing quality control.

This workbook by no means attempts to cover all possible problems. It is hoped, however, that as a result of these tutorial exercises you will begin to develop a "feel" for the type of reasoning and logic needed in weeks of experience and trial-and-error before gaining confidence in maintaining the QA program. You are therefore strongly urged not to become discouraged before reaching this stage if it seems difficult at first.

BACKGROUND

The concepts and procedures for performing a Quality Assurance program on radiographic film processors are discussed in detail in Reference 1. Essentially, the program involves routine (i.e., once or twice daily) exposure of a sheet of control x-ray film to a sensitometer, after which the film is processed.

Control x-ray film is a batch of the same type film used in the department, but which is set aside to be used only for the QA program. There will be very little difference in film speed, contrast or fog among the sheets of film in this batch. A sensitometer is a device which exposes a sheet of film to a controlled, reproducible light source. This light source is generally attenuated by a filter to produce a "stepwedge" image showing grey levels ranging from base plus fog (B + F) to maximum density. When such an exposure is made on a sheet of control film and then processed, any changes in optical density (O.D.) of the step wedge

image can only be due to changes in processing, since both the film and exposure are tightly controlled.

Thus, changes in processing may be characterized by changes in the density of this "stepwedge" image. If the "steps" of this image are plotted vs. optical density (Fig. 1) an "H & D" or "characteristic" curve results. Most diagnostic information is found within the linear portion of this curve. To adequately describe this curve, therefore, only the following information is needed:

(a) The "slope" of the straight line portion. For this, a "density difference" index is calculated. This is the difference in density between two steps: one near the "shoulder" of the curve (2-2.5 O.D.) and one near the "toe" (O.D. 4-6). This serves as an index of contrast.

(b) The position or location of the straight line portion. For this, the density of a mid-density (MD) step (1.0-1.5 O.D.) is recorded. This number locates the line horizontally, and is an index of "speed."

(c) The base plug fog (B + F) level of the curve. For this, the density of an unexposed region of the film is recorded.

On a daily basis, therefore, only these four points (two for density difference, one each for mid-density and base plus fog) are measured, using a densitometer, and recorded. Changes in processing are then determined by comparing these numbers to the desired levels. In the following, processing is considered acceptable if the DD and MD indices are both within desired or optimum values.

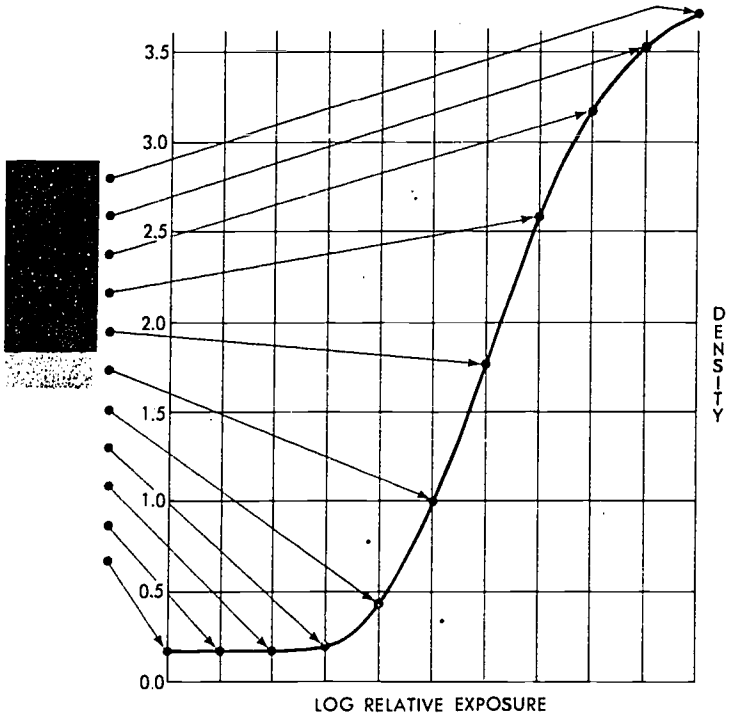


Figure 1. Obtaining an H & D curve from a sensitometric strip.

INSTRUCTIONS

The following is a series of imaginary but very representative examples of processing problems which will normally be found as part of a QA program. Each exercise consists of one such example and is arranged in the following fashion. The first pair of opposing pages shows a portion of a processing control chart and a processor maintenance log to be used in the first exercise. Three pieces of sensitometric data are given under each date/time heading. These are:

(a) Density Difference (DD): This is the difference in optical density of two standardized steps on the sensitometric strip: one with an optical density between 2.0 and 2.5 and the other with an optical density of about 0.5. This number serves as an index of contrast.

(b) Medium Density (MD): This is the optical density of a standardized area on the sensitometric strip with an O.D. around 1.0. This number serves as an index of relative speed.

(c) Base Plus Fog (B + F): This is the optical density of an unexposed portion of the sensitometric strip.

Two sets of data are plotted each working day: one from a sensitometric strip processed about 9:00 a.m. and the other processed about 3:00 or 4:00 p.m. Each "gap" in the charts corresponds to a weekend when no sensitometry was performed.

The last entry on each chart is a set of circled data points which fall outside the control limits and therefore require corrective action. The portion of the processor maintenance log facing this chart contains entries of all actions taken on the processor before the deviation occurred and thus represents the processor's "recent history". All actions are recorded: those done routinely as well as corrective actions. You should use the log and control chart in conjunction with any other knowledge available to "deduce" the probable cause of the problems and the suggested corrective procedures. Since the developer temperature should be read whenever a sensitometric strip is made, this factor should be assumed, although it is not included in the exercise. In many cases, therefore, you must propose two possible courses of action: one assuming improper developer temperature and the other assuming proper developer temperature. The course of action developed should include both the steps to be taken in finding the cause and those taken to correct it.

The second pair of opposing pages shows the maintenance log after the appropriate corrective actions have been taken and a detailed evaluation and discussion of the example. In many cases, suggestions or advice will be given in order to prevent or minimize that type of problem.

These four-page sets make up each succeeding exercise. Think carefully about each problem before turning to the answer on the next page. Sometimes there will be no apparent way to correctly interpret the problem from the data given. This is intended, since such situations may often be encountered in practice, and can only be handled through experience. Occasionally, you are referred to the "manual" for further information. This manual is given in Reference 1.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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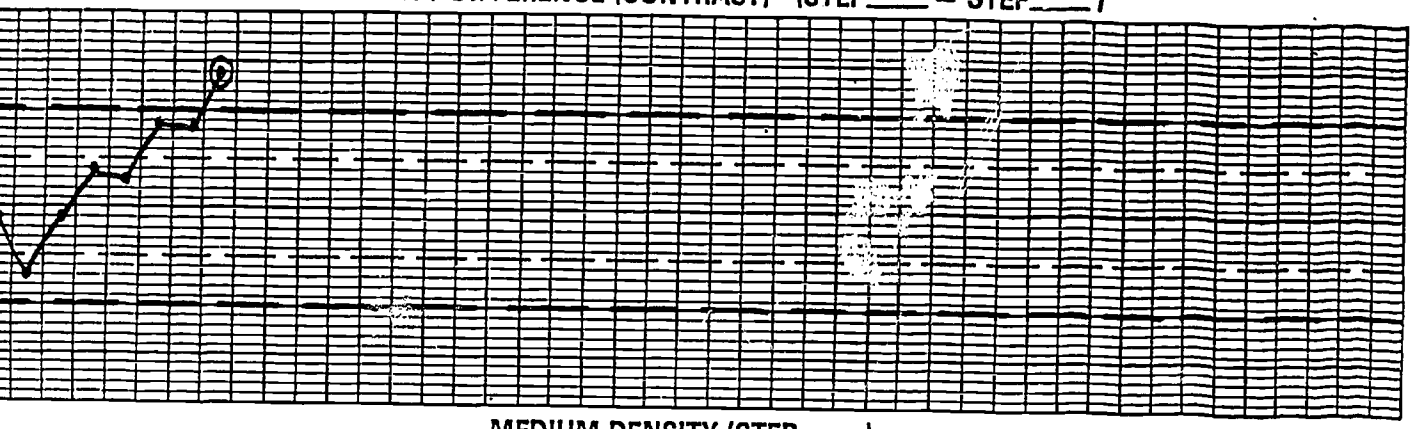
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY:
CL - Cleaned
CC - Total Chemistry Change
CD - Changed Developer
CF - Changed Fixer
RI - Increased Replenishment Rate
RL - Lowered Replenishment Rate
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

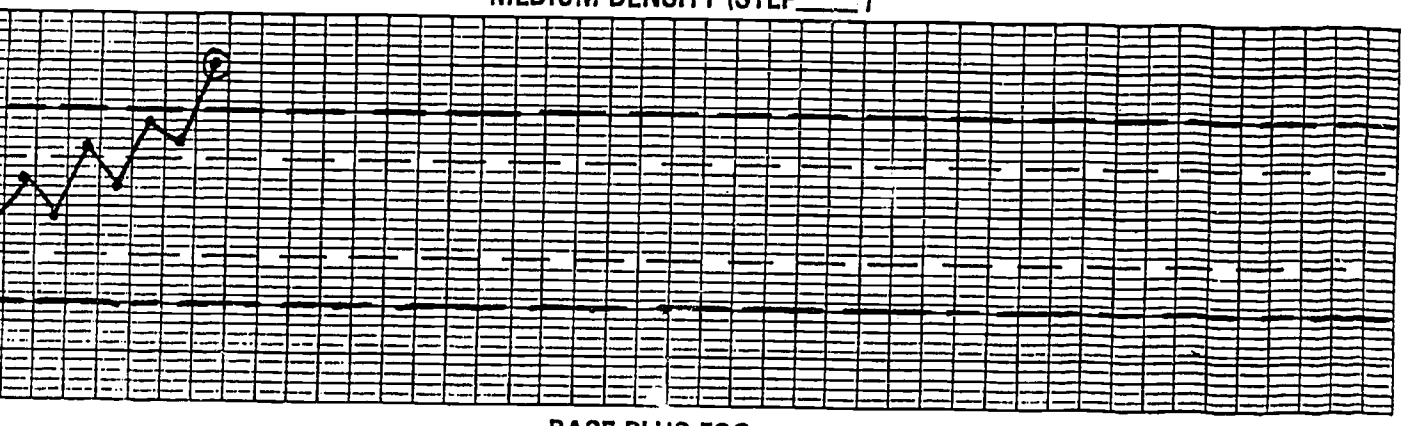
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

2	2	3	3	4	4	5	5
9	3	9	3	9	4	10	3

DENSITY DIFFERENCE (CONTRAST) (STEP____ – STEP____)



MEDIUM DENSITY (STEP____)



BASE PLUS FOG

19	20	20	20	19	20	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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MR - Mechanical Repair
OT - Other (comment)

ANSWER: Over-replenishment

CORRECTIVE ACTION: Turn back replenishment rate and run several fully exposed films (i.e., films that have been exposed to visible light.)

EXPLANATIONS: Since both the speed and contrast indices are high, the indication is that there has been an increase in either developer temperature or chemical activity (strength). Usually, the developer temperature is measured routinely and found to be normal (in this case, 92°). Thus, the source of the problem is probably in the developer chemistry. The fact that a gradual upward trend is evidenced during the week points to the replenishment rate being too high as the cause. That is, as each film is processed, a little more new developer is added via replenishment than is used up by the film's development, thus gradually increasing the strength of the chemicals in the developer tank. Turning down the replenishment rate will alleviate this problem, although the precise amount of reduction depends on the individual facility and must be determined by trial and error. This corrective action alone, however, may not bring the processor back to within the control limits for several days. Thus, in addition, several fully exposed films should be run through the processor until the processor is back within the normal limits. These fully exposed films reduce developer strength by using much more developer in their processing than is replaced through replenishment.

You will observe that in this exercise the replenishment rate had been increased earlier in the week, apparently in response to under-replenishment. In practice, it will be found that improper replenishment is a common source of improper development, since variation in patient load, types of exams, film processing practices, and even the amount of chemicals in the replenisher tanks can affect the amount of replenishment.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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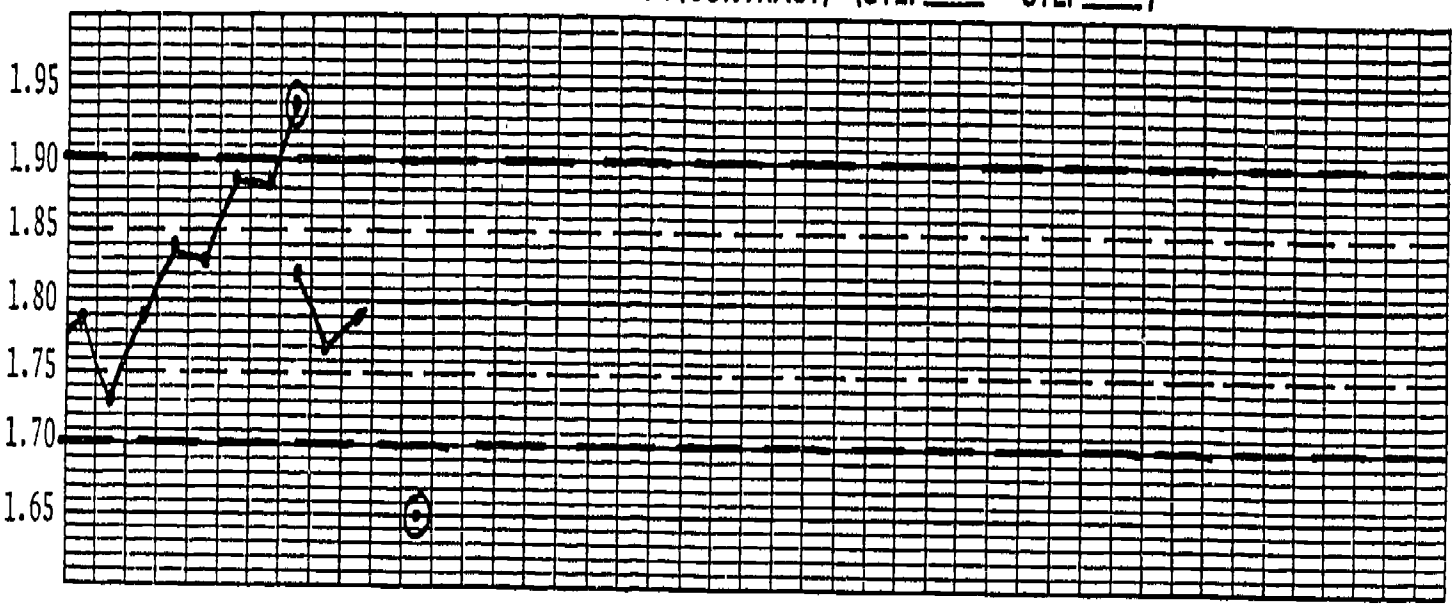
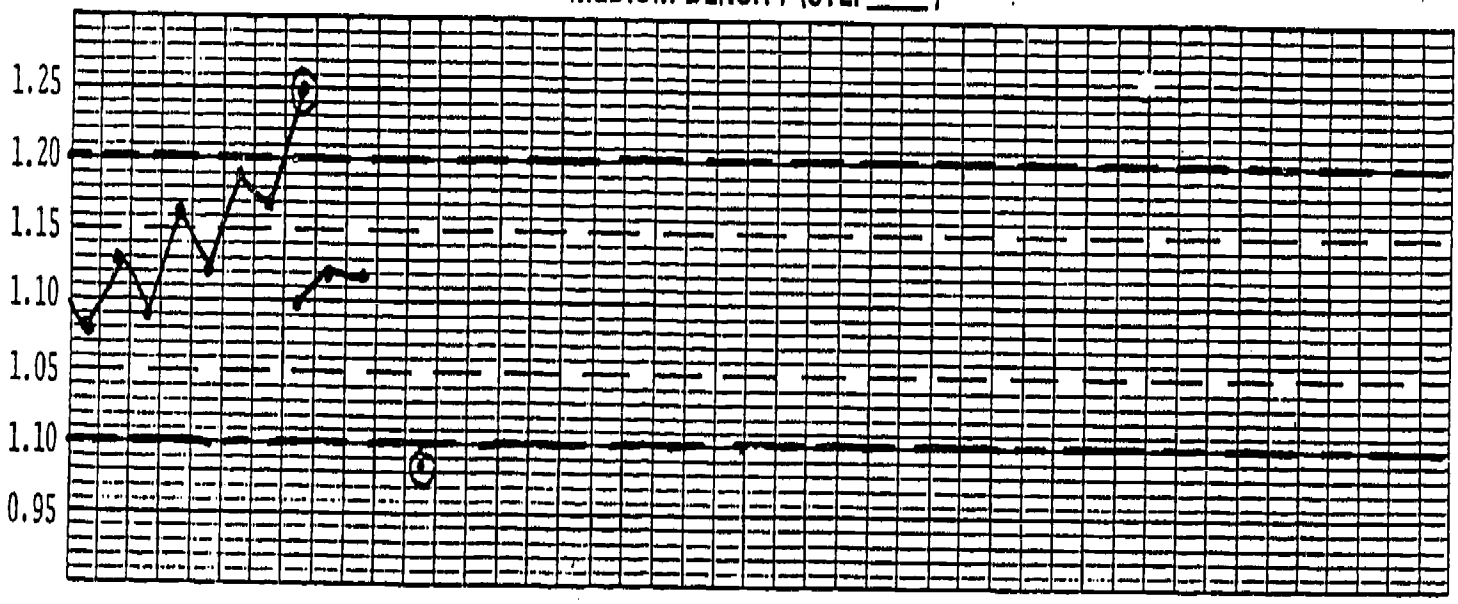
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	2	2	3	3	4	4	5	5	6	6		9
TIME	9	3	9	3	9	4	10	3	9	3		9

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	20	20	20	19	20	20	19	20		20	

D-MAX

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Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
3/9	9:00 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - added 100ml replen.
3/10	12:30 am (pm)	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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KEY:
- CL - Cleaned
- CC - Total Chemistry Change
- CD - Changed Developer
- CF - Changed Fixer
- RI - Increased Replenishment Rate
- RL - Lowered Replenishment Rate
- MD - Mixed New Developer Replen.
- MF - Mixed New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Oxidation and/or evaporation of the developer chemicals.

CORRECTIVE ACTION: Addition of replenisher directly into developer tank.

EXPLANATION: This type of problem is very common in most facilities (and, in fact, may be the norm) after lengthy periods of low volume processing such as after a weekend. It is the result of interaction of the developer chemicals with the atmosphere, causing oxidation and reduced chemical strength. Since the same chemicals have been sitting in the processor for many hours, the cumulative effect of the oxidation over this period of time can be sufficient to noticeably reduce the chemical activity. In most cases, the effect will be more pronounced in the contrast index than in the speed index. The reason is that there are actually two different "developing" chemicals in all developers. These are usually phenidone, which quickly produces the "greys", and hydroquinone, which more slowly produces the "blacks" on the final radiograph. The second chemical, hydroquinine, is more suceptible to chemical oxidation. Since a high density 'black" area on the sensitometric strip is used to calculate the contrast index, this index is more affected by oxidation than the mid-density speed step. Again, this problem will very often be found after a long period of low volume processing, and it is therefore very important that the processor be checked before running any patient films at these times.

The problem is corrected by simply adding new developer directly to the developer tank. This may be done in three ways: take the cover off the processor and carefully pour some developer replenisher into the developer tank in, for example, 100 ml increments until the control region is reached; or, manually trip the replenisher microswitches for a few moments causing replenisher to be dumped into the processor; or run some previously processed films (such as retakes). The last is often the easiest and merely causes replenishment with little use of developer.

ACTIONS ON PROCESSOR

Date	Time		Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15	(am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10	am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10	am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
3/9	9:00	(am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Oxidation - added 100ml Replen.
3/10	12:30	am (pm)	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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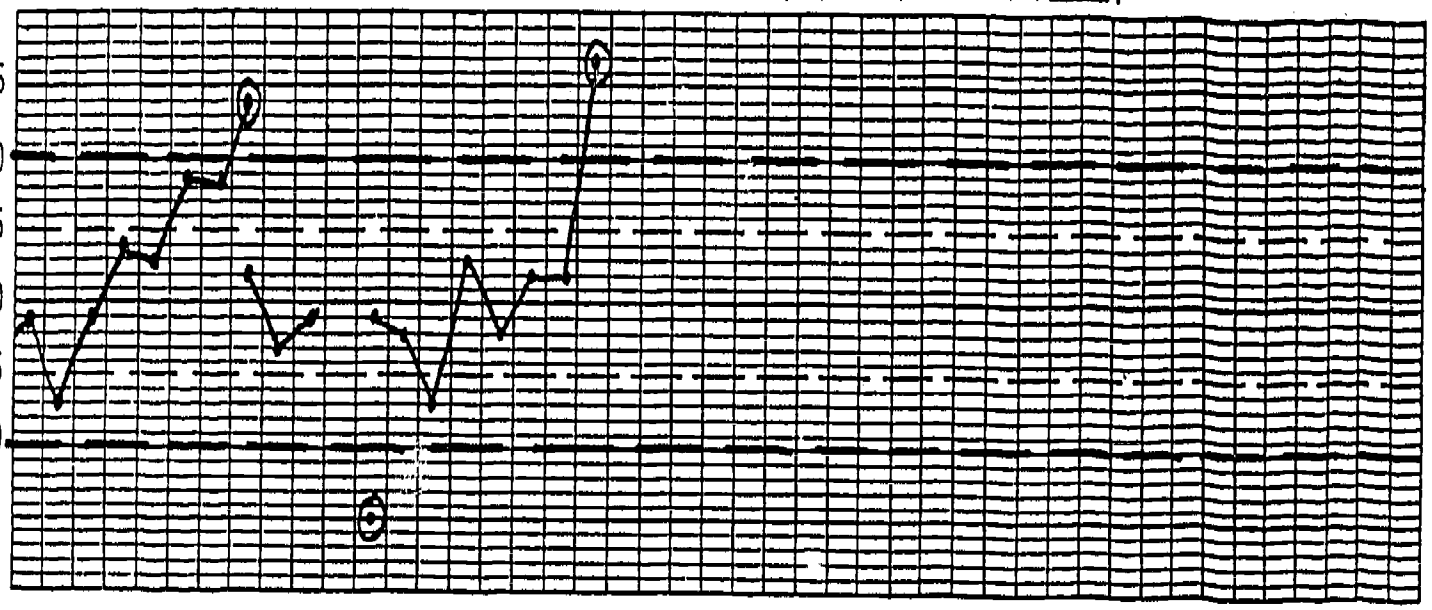
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

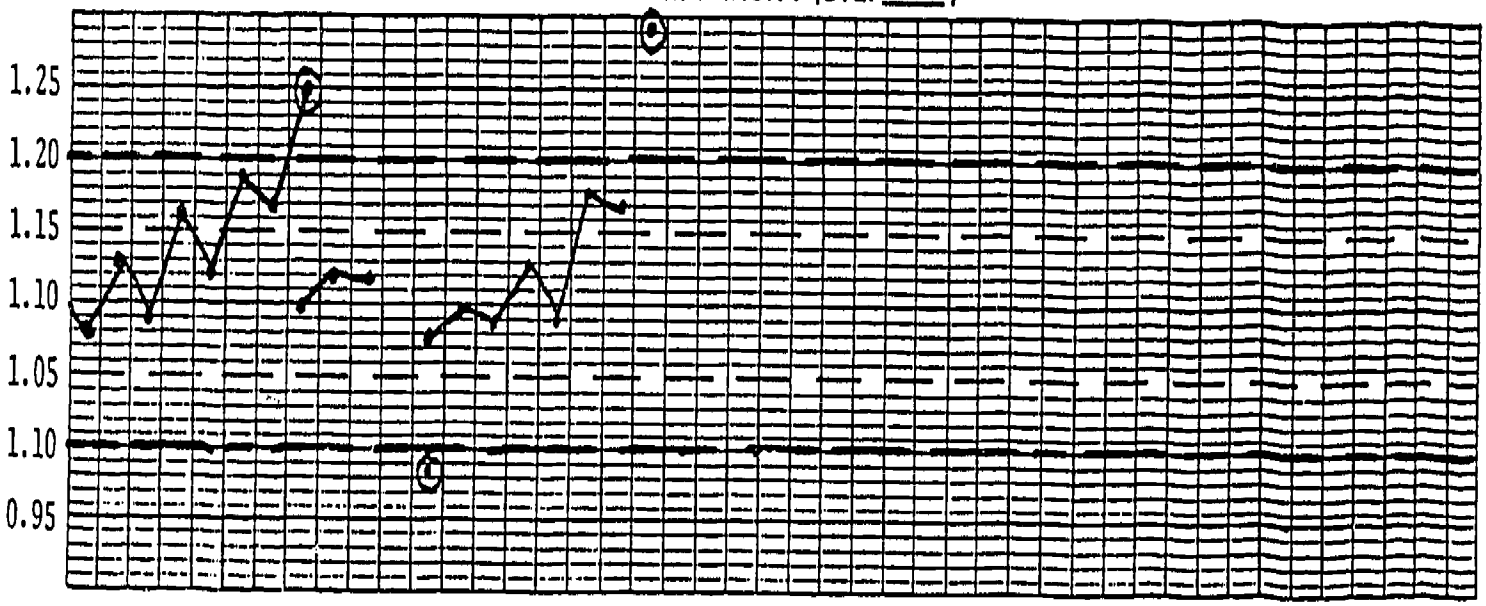
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	2	2	3	3	4	4	5	5	6	6		9	9	10	10	11	11	12	12
TIME	9	3	9	3	9	4	10	3	9	3		9	4	10	4	9	3	10	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	20	20	20	19	20	20	19	20		20	20	19	19	20	20	20	22

D-MAX

ACTIONS ON PROCESSOR

Date	Time	am/pm	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15	**am** pm	CL CC CD CF **RI** RL MD MF TD TW MR OT	.65	.80	
3/5	3:10	am **pm**	CL CC CD CF RI **RL** MD MF TD TW MR OT	.80	.70	
3/5	3:10	am **pm**	CL CC CD CF RI RL MD MF TD TW MR **OT**			Ran 10 Fully Exposed films
3/9	9:00	**am** pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			Oxidation-added 100ml Replen.
3/10	12:30	am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	80°	88°	
3/12	4:20	am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	91°	87°	
3/16	6:00	am **pm**	**CL** **CC** CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Developer temperature too high due to excessive wash water temperature.

CORRECTIVE ACTION: Reduce wash water temperature to proper setting.

EXPLANATION: As usual, the increase in all three monitored indices (contrast, speed, and base plus fog) points first to excessive developer temperature. In this case, the thermometer reading indicated a developer temperature of 94° instead of the normal 92° for this processor. The normal impulse in these situations is to reduce the developer thermostat setting. It is strongly emphasized, however, that developer temperature problems are usually not caused by the thermostat, but by some other source of temperature fluctuation. The most probable culprit in non-cold water processors is the temperature or pressure of the wash water circulating through the developer heat exchanger. This water should normally be 4 to 5° cooler than the desired developer temperature. If it is hotter than this, its heat exchanging capacity is greatly reduced. The resultant insufficient cooling of the recirculating developer allows the higher temperature in this example to occur. (In cold-water systems make sure that the water temperature is at least 4 to 5° lower than the desired developer temperature.)

Several factors can affect the wash water temperature: alteration of the wash water temperature setting; a surge or drop in the incoming hot or cold water pressure; or, a change in the temperature of either the hot or cold incoming water lines. In each case, the temperature of the mixed wash water will be altered.

In this case the wash water temperature setting was increased earlier in the week from 80 to 88°, as noted in the processor maintenance log. The cause, apparently was not an improper temperature setting, but a change in the temperature of the incoming water. When this later returned to normal, the wash water was found to be too hot (91°), causing the observed problem.

These conditions may be avoided by the following practices:

(1) Do not alter a mechanical setting unless it is fairly certain that the setting is incorrect and not just the result of temporary environmental conditions.

(2) Pressure and temperature gauges should be installed in both the incoming hot and cold water lines in addition to the single ones usually installed at the mixing valve; this will allow easy determination of external water-related problems.

(3) If a water problem is suspected, keep an eye on it and correct immediately if the problem recurs.

NOTE: A routine processor cleaning and chemistry change is entered in the maintenance log. It is important that all actions taken on the processor be entered in this log, and not just corrective actions taken in response to a problem. Many future problems may be traced to these routine procedures.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 **am** pm	CL CC CD CF **RI** RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am **pm**	CL CC CD CF RI **RL** MD MF TD TW MR OT	.80	.70	
3/5	3:10 am **pm**	CL CC CD CF RI RL MD MF TD TW MR **OT**			Ran 10 Fully Exposed films
3/9	9:00 **am** pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			oxidation - added 100ml Replen.
3/10	12:30 am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	80°	88°	
3/12	4:20 am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	91°	87°	
3/16	6:00 am **pm**	**CL** **CC** CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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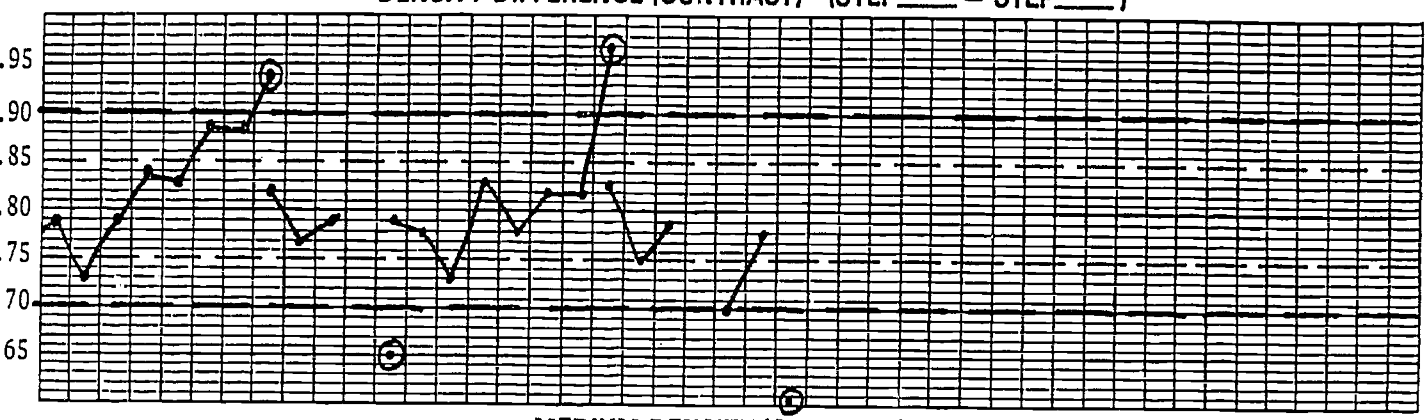
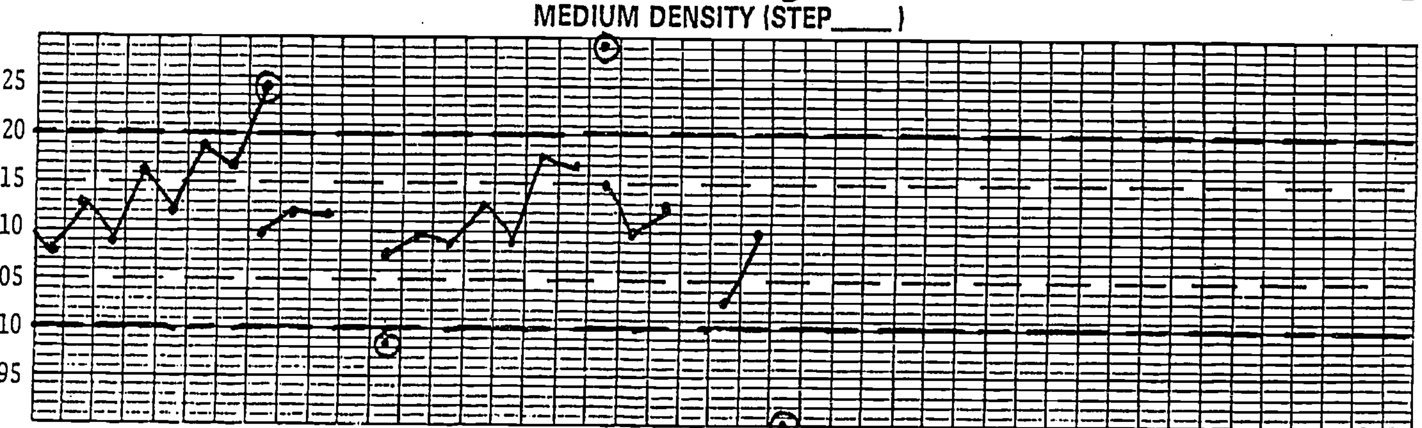
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

ATE	2	2	3	3	4	4	5	5	6	6		9	9	10	10	11	11	12	12	13	13		16	16	17
IME	9	3	9	3	9	4	10	3	9	3		9	4	10	4	9	3	10	4	9	4		8	3	8

DENSITY DIFFERENCE (CONTRAST) (STEP____ – STEP____)



MEDIUM DENSITY (STEP____)



BASE PLUS FOG

20	19	20	20	20	19	20	20	19	20		20	20	19	19	20	20	20	22	20	20		19	20	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
3/9	9:00 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Oxidation - added 100ml Replsn.
3/10	12:30 am (pm)	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
3/12	4:20 am (pm)	CL CC CD CF RI RL MD MF TD (TW) MR OT	91°	87°	
3/16	6:00 am (pm)	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15 (am) pm	CL (CC) CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

18

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MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: Developer contaminated with fixer.

CORRECTIVE ACTION: Drain and flush developer tank; refill and restart.

EXPLANATION: The sharp drop in both the speed (MD) and contrast (DD) again suggests either a temperature drop or a problem with the chemistry. This time, the developer temperature is normal. As is often the case, a clue to the problem's source can be obtained from the maintenance log. You can see that the chemistry was changed following a routine processor cleaning which had been done the evening before. A problem associated with this change should be the first item suspected. The sharp drop in the processing in this suggests contamination of the developer with fixer.* It does not require much fixer to cause this amount of contamination, and could easily be the result of splash-over of fixer into the developer tank during refilling.

The proper protocol to follow to avoid this problem is to refill the fixer tank first, with a cover over the developer tank. A quick flushing of the developer tank with water will remove any fixer residue. The developer tank may then be refilled without fear of contamination.

Actually, it is difficult in this instance to ascertain that fixer contamination is the cause of the problem. It could, for example, have been the result of adding too much starter solution. In either case, the corrective procedure is the same, and should be taken without spending excessive time determining the precise cause. If it later becomes evident that the chemistry change was not at fault, other possibilities may be then pursued.

*Actually, for several film-chemistry combinations, a significant increase in developer activity may occur after contamination by small amounts of fixer (2).

ACTIONS ON PROCESSOR

Date	Time		Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15	**am** pm	CL CC CD CF **RI** RL MD MF TD TW MR OT	.65	.80	
3/5	3:10	am **pm**	CL CC CD CF RI **RL** MD MF TD TW MR OT	.80	.70	
3/5	3:10	am **pm**	CL CC CD CF RI RL MD MF TD TW MR **OT**			Ran 10 Fully Exposed films
3/9	9:00	**am** pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			oxidation - added 100ml replsn.
3/10	12:30	am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	80°	88°	
3/12	4:20	am **pm**	CL CC CD CF RI RL MD MF TD **TW** MR OT	91°	87°	
3/16	6:00	am **pm**	**CL** **CC** CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15	**am** pm	CL **CC** CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- TD - Developer Temperature Adjust.
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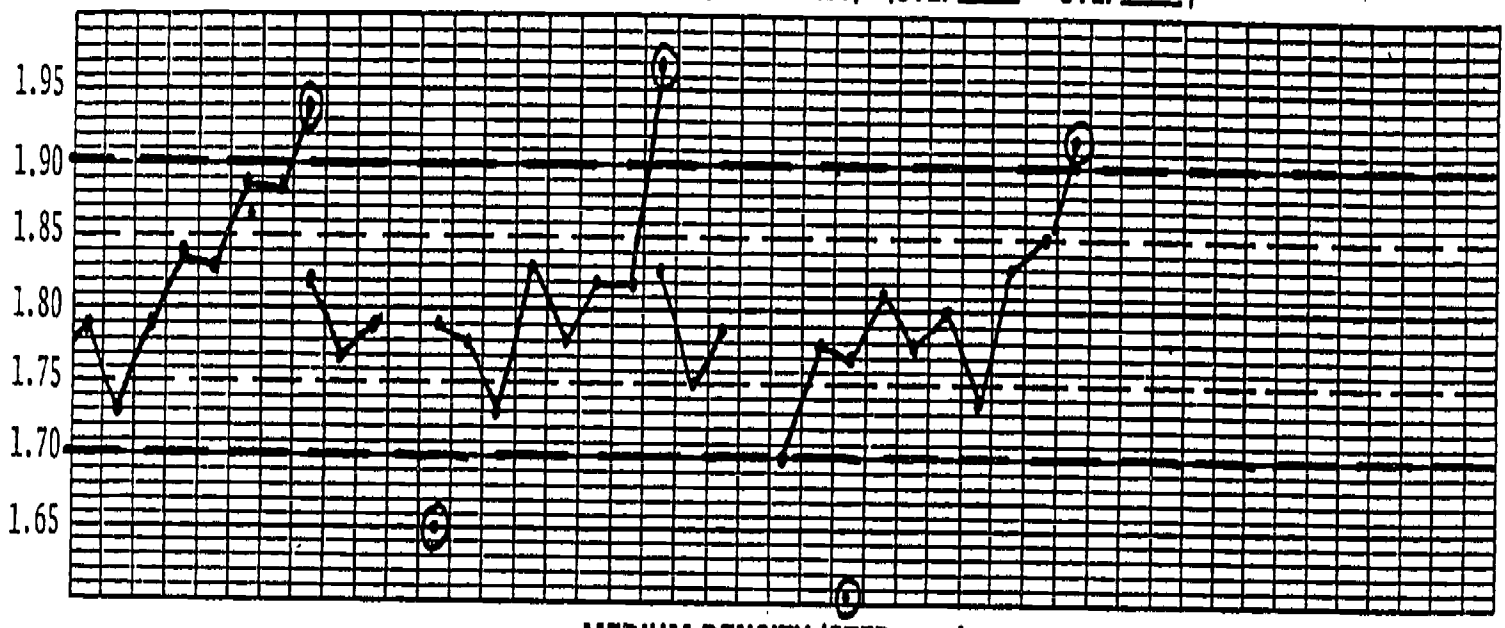
- MR - Mechanical Repair
- OT - Other (comment)

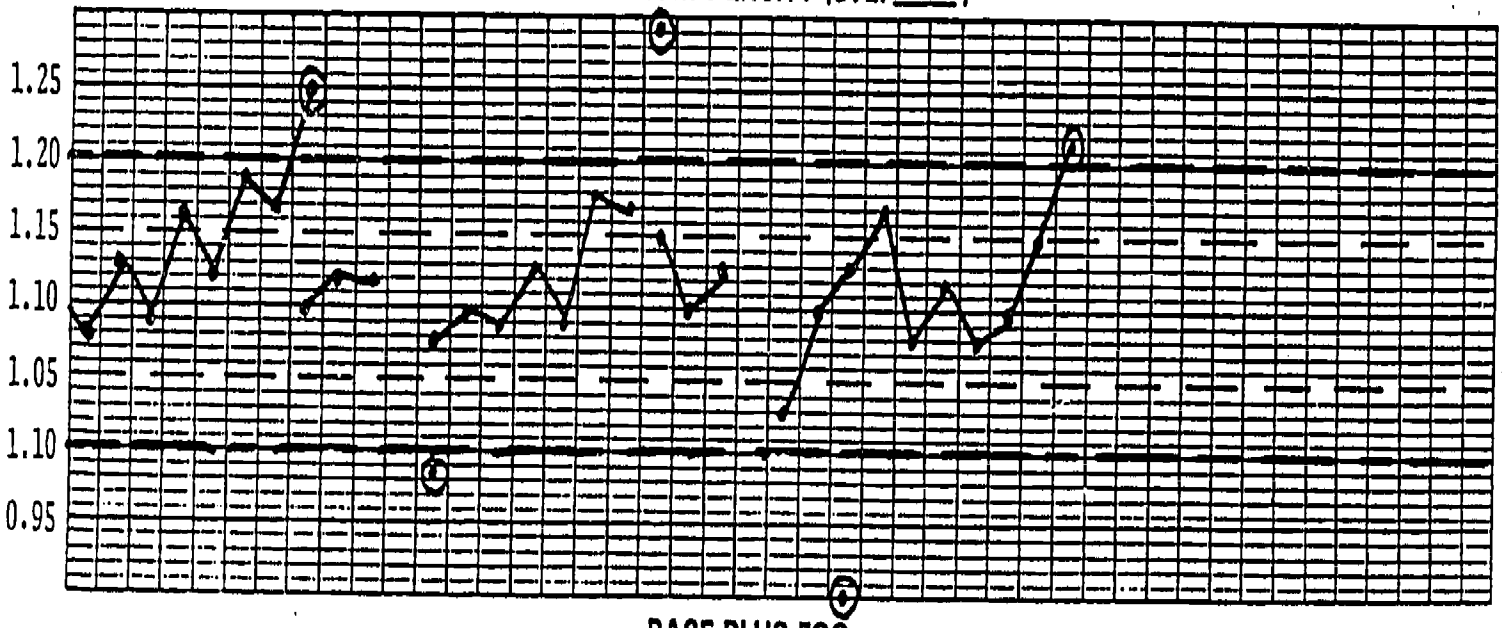
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	2	2	3	3	4	4	5	5	6	6		9	9	10	10	11	11	12	12	13	13		16	16	17	17	18	18	19	19	20	20
TIME	9	3	9	3	9	4	10	3	9	3		9	4	10	4	9	3	10	4	9	4		8	3	8	4	9	4	9	4	9	3

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	20	20	20	19	20	20	19	20		20	20	19	19	20	20	20	22	20	20		19	20	20	20	19	19	20	20	20	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 (pm) am	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully exposed films
3/9	9:00 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - added 100ml rsplen.
3/10	12:30 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
3/12	1:30 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	91°	87°	
3/16	6:00 (pm) am	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15 pm am	CL (CC) CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
3/20	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Heavy workload - 10 fully exp.
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			films run to correct
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Excessive replenishment due to unusually heavy patient load.

CORRECTIVE ACTION: Run several fully exposed films or change chemistry.

EXPLANATION: The purpose of this exercise is twofold: to demonstrate another cause of improper replenishment, and to point out the important fact that one cannot isolate the processing QA program from other "goings-on" in the department.

In this example both the MD and DD are again on the high side. The developer temperature checks out okay, and no recent actions have been taken on the processor. No trend is visible from the sensitometric data. The next logical step is to "ask around", and find out if anything unusual occurred in the department that could be linked to the problem. In this case, it was determined that there was an unusally heavy workload of chest exams that day, which resulted in the excessive replenishment. Since the replenishment rate is set for an "average" workload and distribution of exams, isolated instances of heavy workload or abnormal exam frequency can cause isolated cases of improper replenishment.

The problem may be corrected by either changing chemistry or by running several fully exposed films. (These should be green films known to be bad, for example, fogged, and not film taken from the bin. The latter is costly of film, and it would be easier and cheaper to simply dump the chemistry and start over).

Two words of caution are in order.

(1) If no apparent cause of the improper processing is found within a reasonable period of time (30 minutes or less), then make the necessary correction without trying to determine the cause and look further only if it reappears.

(2) Many people like to "assume" a cause of the problem (such as excessive replenishment rate) and take corrective action accordingly. This will usually cause more problems than it corrects and is strongly discouraged.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 (pm) am	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
3/9	9:00 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - added 100ml replsn.
3/10	12:30 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
3/12	4:20 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	91°	87°	
3/16	6:00 (pm) am	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15 pm am	CL (CC) CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
3/20	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Heavy workload - 10 fully exp.
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			films run to correct
3/23	5:00 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			New box of control film opened
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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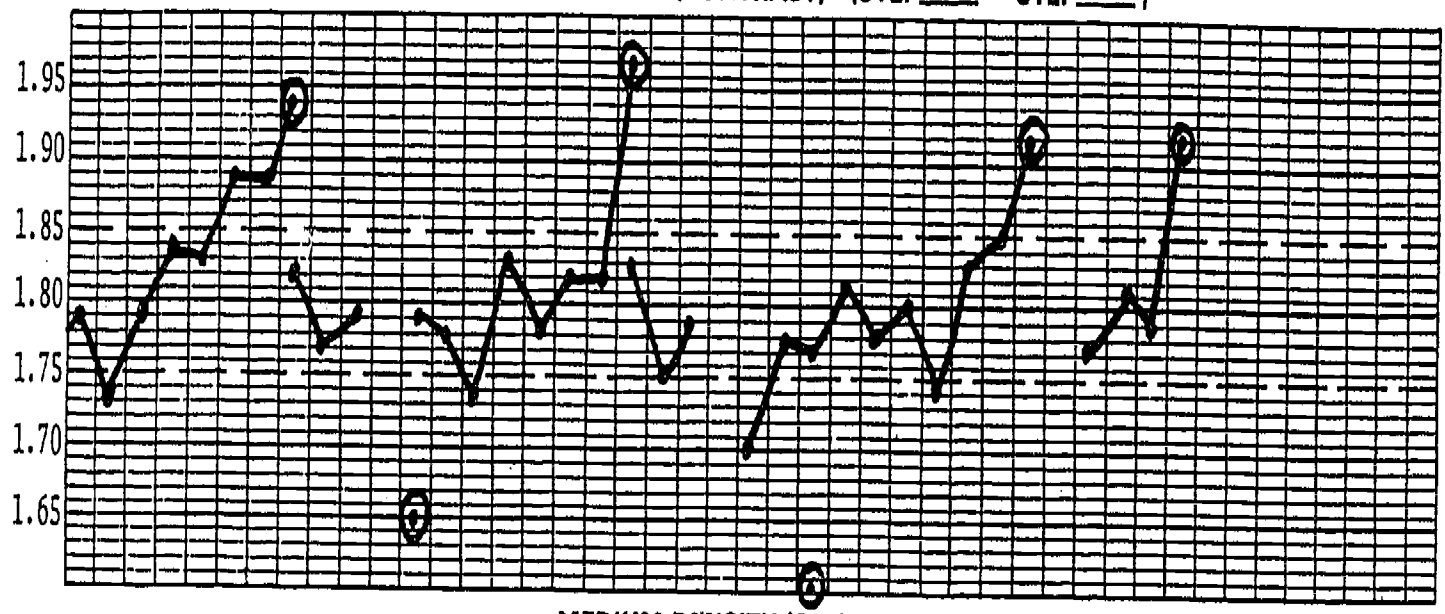
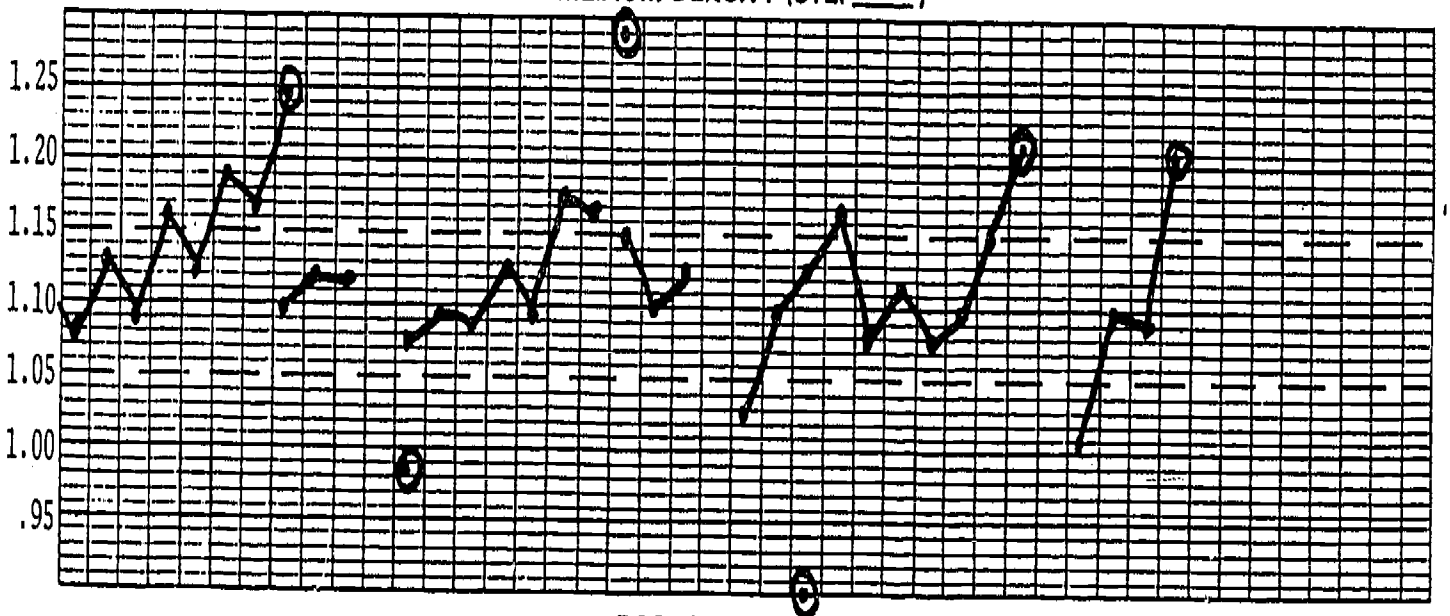
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	2	2	3	3	4	4	5	5	6	6	9	9	10	10	11	11	12	12	13	13	16	16	17	17	18	18	19	19	20	20	23	23	24	24
TIME	9	3	9	3	9	4	10	3	9	3	9	4	10	4	9	3	10	4	9	4	8	3	8	4	9	4	9	4	9	3	8	4	9	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	20	20	20	19	20	20	19	20		20	20	19	19	20	20	20	22	20	20		19	20	20	20	19	19	20	20	20	20		20	20	19	19

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 (am) pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 (pm) am	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 fully exposed films
3/9	9:00 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - added 100ml replen.
3/10	12:30 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
3/12	4:20 (pm) am	CL CC CD CF RI RL MD MF TD (TW) MR OT	91°	87°	
3/16	6:00 (pm) (am)	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15 pm am	CL (CC) CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
3/20	3:10 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Heavy workload - 10 fully exp.
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			films run to correct
3/23	5:00 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			New box of control film opened
3/24	4:15 (pm) am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Forgot new control limits (new box)
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY: CL - Cleaned
CC - Total Chemistry Change
CD - Changed Developer
CF - Changed Fixer
RI - Increased Replenishment Rate
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MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: New operating levels not made for new box of control film.

CORRECTIVE ACTION: Prepare new chart with properly reset operating levels and control limits.

EXPLANATION: Here again, the processor maintenance log suggests the problem's origin: a new box of control film was opened the previous day without changing the operating levels and control limits on the chart. Although individual boxes of film will usually be very close in sensitometric properties to each other (especially those within the same batch and emulsion number), it is not uncommon to have boxes different in speed by as much as 0.1 optical density units in the mid density range. If new operating levels are not made on the processor control chart to account for these differences, changes in the processor monitoring indices may be observed although there has been no change in the processing whatsoever. It is therefore important that such film differences be evaluated whenever a new box of control film is opened.*

This procedure for determining new operating levels is discussed in the manual. Briefly, however, the last few sheets of film from the "old" control box should be sensitometrically exposed and processed along with a few strips from the "new" box of control film. The MD, DD, and B + F from the "old" strips should be averaged and compared to the same averages from the "new" strips. The differences between the two MD and DD averages indicate the amount by which the new limits should be changed. For example, if the average MD from the "old" box was 1.10 and the average MD from the "new" box was 1.15, the operating levels for the new chart must be moved up to 0.05 O.D. on the MD plot.

In this case, it was found that the MD and DD had to be moved up 0.10 units. (The limits have not been changed in these examples, although in "real life", all future charts would have been shifted upward).

*It is a good idea to similarly evaluate samples of all film and not just control film, to screen out batches of film with excessively large (more than about 0.15 O.D.) differences in speed or contrast.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/2	9:15 am/pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.65	.80	
3/5	3:10 am/pm	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.70	
3/5	3:10 am/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Ran 10 Fully Exposed films
3/9	9:00 am/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - added 100ml replen.
3/10	12:30 am/pm	CL CC CD CF RI RL MD MF TD (TW) MR OT	80°	88°	
3/12	4:20 am/pm	CL CC CD CF RI RL MD MF TD (TW) MR OT	91°	87°	
3/16	6:00 am/pm	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
3/17	8:15 am/pm	CL (CC) CD CF RI RL MD MF TD TW MR OT			Devel. contaminated with Fixer
3/20	3:10 am/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Heavy workload - 10 fully exp.
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			films run to correct
3/23	5:00 am/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			New box of control film opened
3/24	4:15 am/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Forgot new control limits (new box)
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am/pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY: CL - Cleaned
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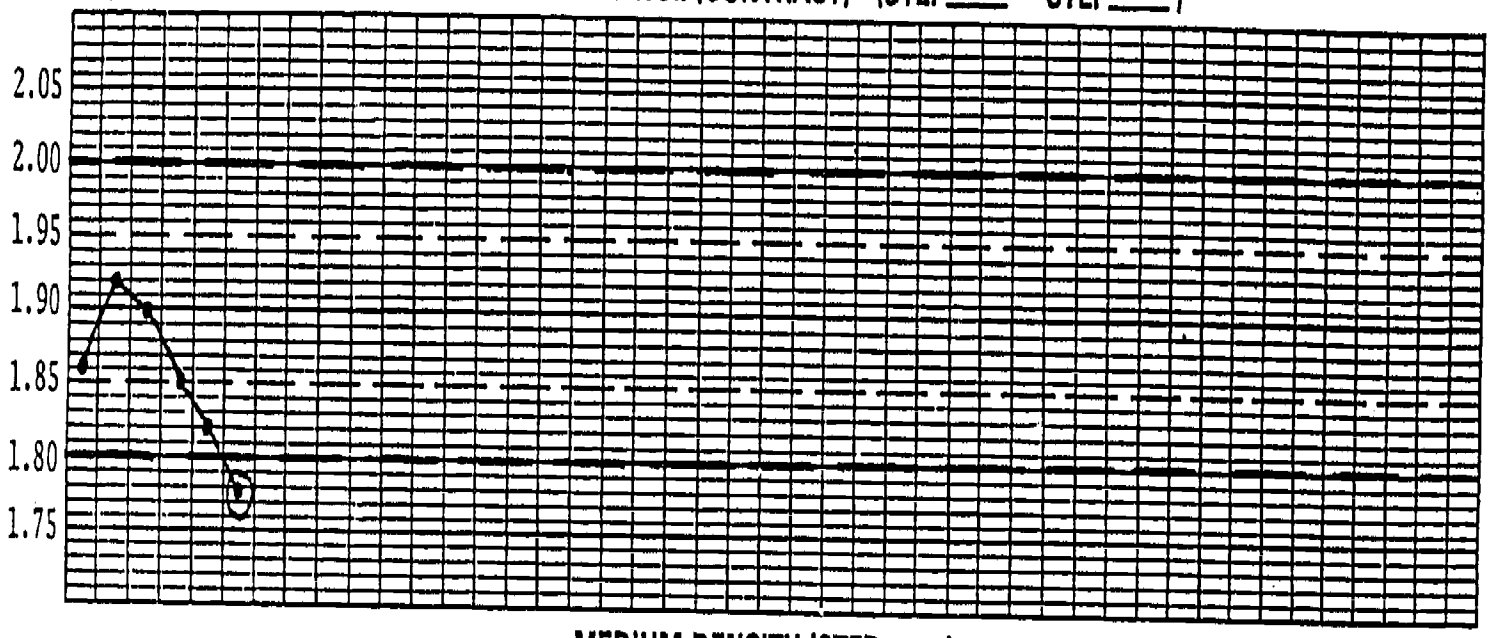
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

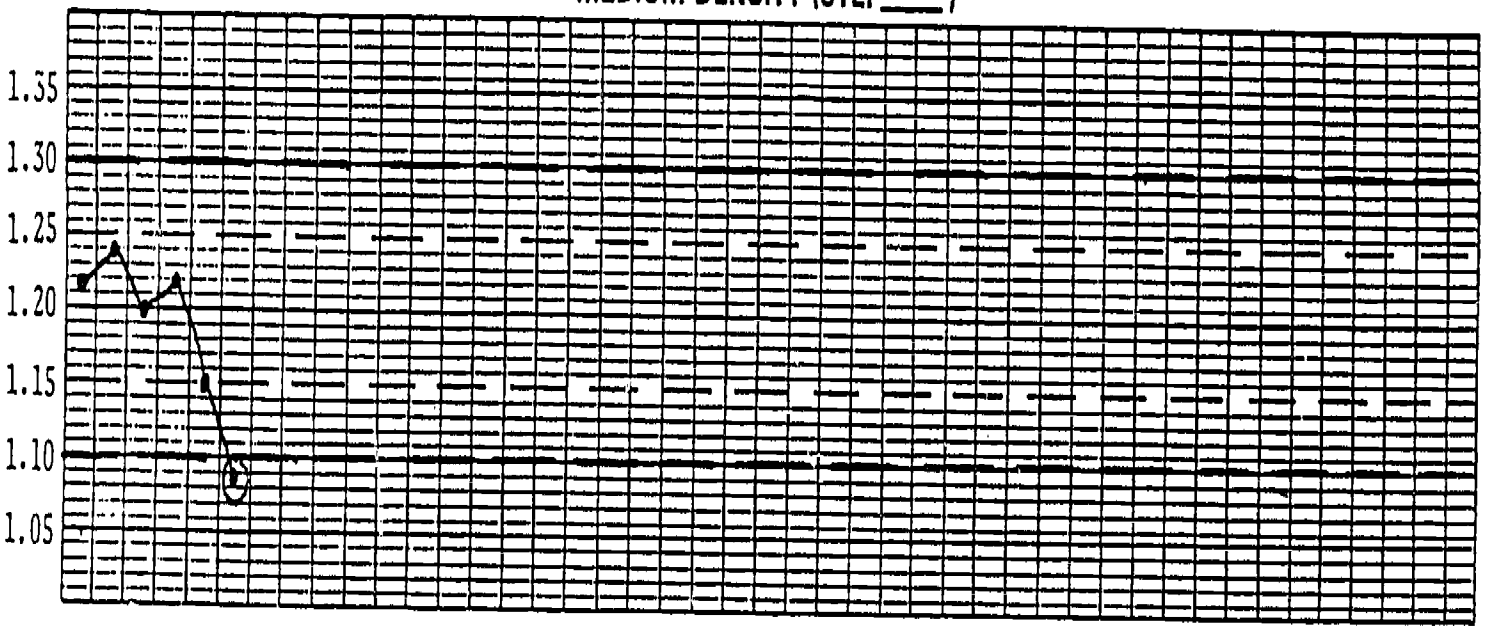
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	25	25	26	26	27	27
TIME	9	4	9	4	9	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- MF - Mixed New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Under-replenishment

CORRECTIVE ACTION: Increase replenishment rate and add some replenisher directly to processor to bring it back to within control limits.

EXPLANATION: In this example as in the first, a gradual reduction in development has occurred. As before, this is generally the earmark of improper replenishment causing a gradual falloff in developer strength. In this case, the inadequate replenishment rate meant that on the average, each radiograph was using up more developer than was replaced.

The proper corrective action is to increase the replenishment rate. Also, additional replenisher should be added directly to the processor developer tank (in about 100 ml increments) until the processing is back inside the control limits. This again may be done either by manually tripping the microswitches, by using a container to pour it right into the developer tank, or by processing several previously processed films.*

*It should be noted that here and elsewhere the processing of previously developed films is suggested as part of a corrective or routine procedure. There had in the past been opinions against this practice, since residual fixer in the film could cause developer contamination. However, if these films are being adequately washed, little if any fixer should remain, and the re-processing of a limited number should not be a problem. In fact, their use, as well as the use of fogged or expired film for processor cleanup, lead films for single-emulsion roll film and correction actions can avoid the wasteful and costly use of "good" film from the film bin.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- TD - Developer Temperature Adjust.
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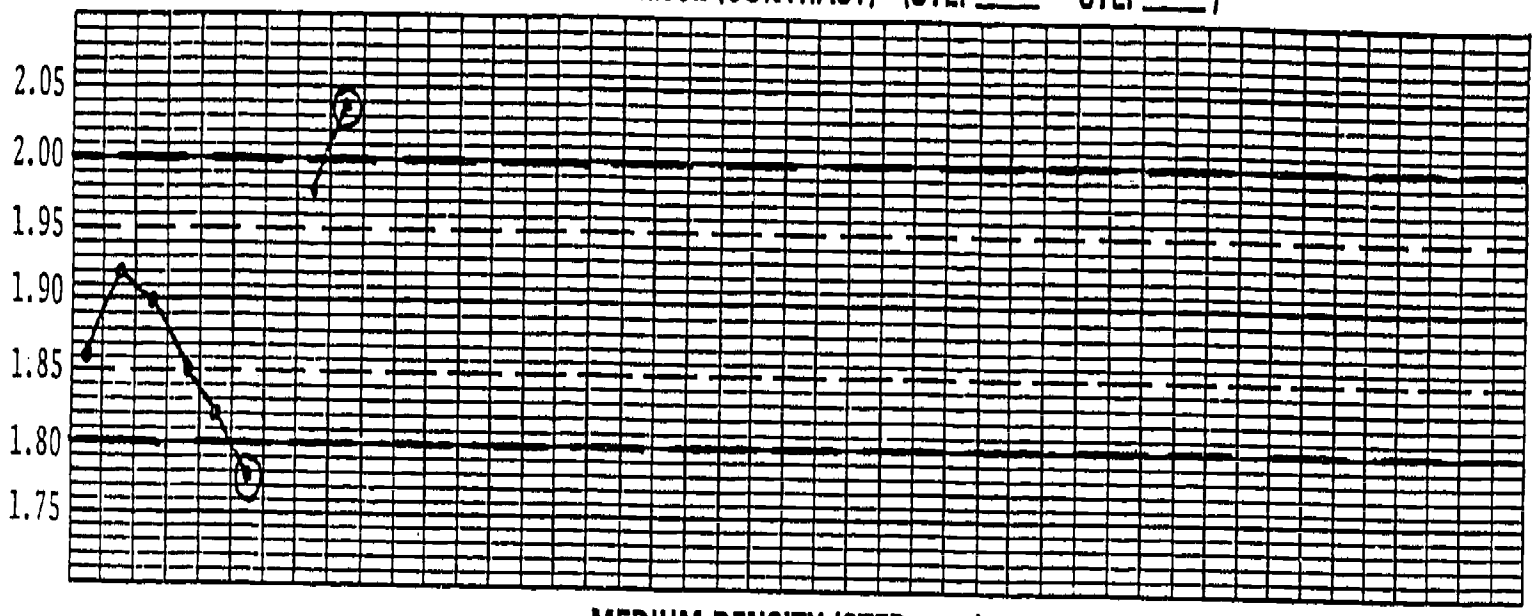
- MR - Mechanical Repair
- OT - Other (comment)

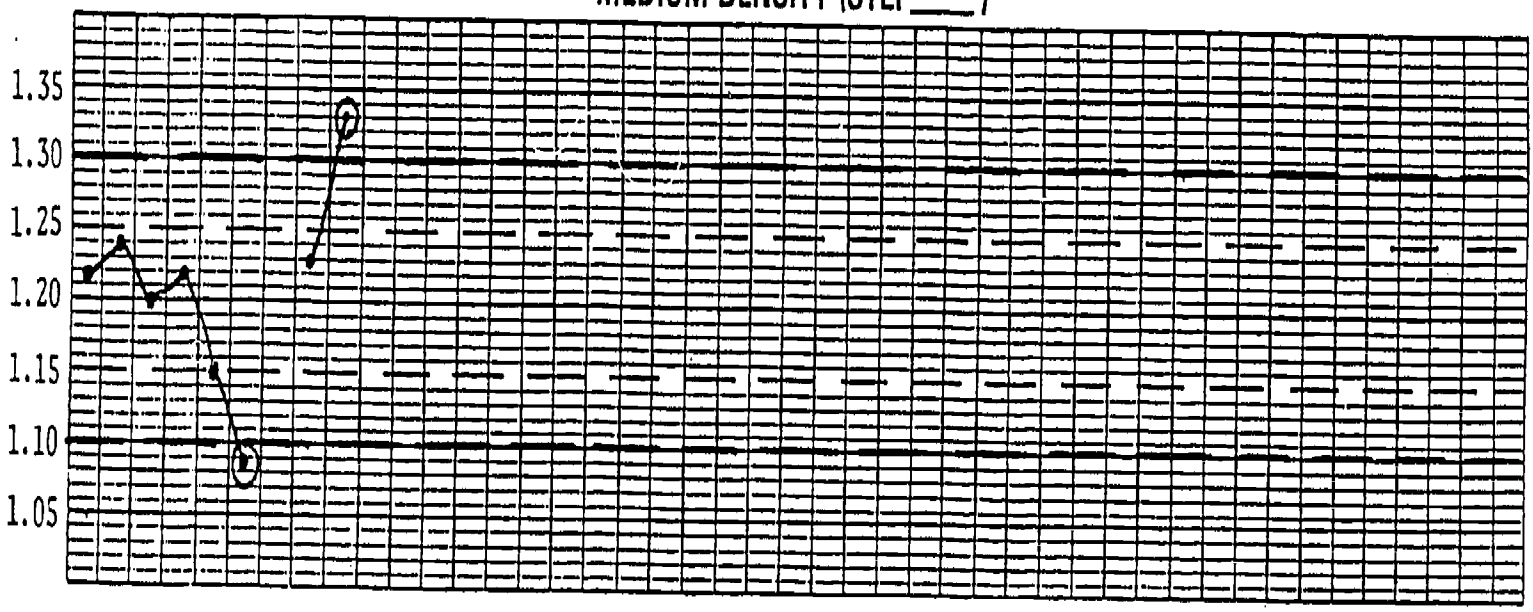
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH

DATE	25	25	26	26	27	27		30	30
TIME	9	4	9	4	9	4		8	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ -- STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20	20	20	

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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MR - Mechanical Repair
OT - Other (comment)

ANSWER: Replenisher too concentrated.

CORRECTIVE ACTION: Dilute replenisher to proper level as indicated by hydrometer. Either dump and restart the developer tank or run several fully exposed films.

EXPLANATION: The maintenance log shows that new developer replenisher was mixed just the prior afternoon. Thus after first checking for normal developer temperature, explore the possibility of excessively strong (too concentrated) replenisher. Obtain from the manufacturer the specific gravity of the properly mixed replenisher (for that batch number) and compare it to the hydrometer reading taken from the replenisher after correcting the reading for temperature in the tank, (not the tank inside the processor). If the specific gravity is higher than the manufacturer specification, then the replenisher was insufficiently diluted when it was mixed.

The proper corrective action is to add additional water to the tank in small (2-4 liters) increments until the proper specific gravity is reached. Since it may take a while for this action alone to restore proper processing levels through replenishment, either the developer in the processor itself should be drained and restarted, or several fully exposed films should be processed to lower the chemical strength of the developer.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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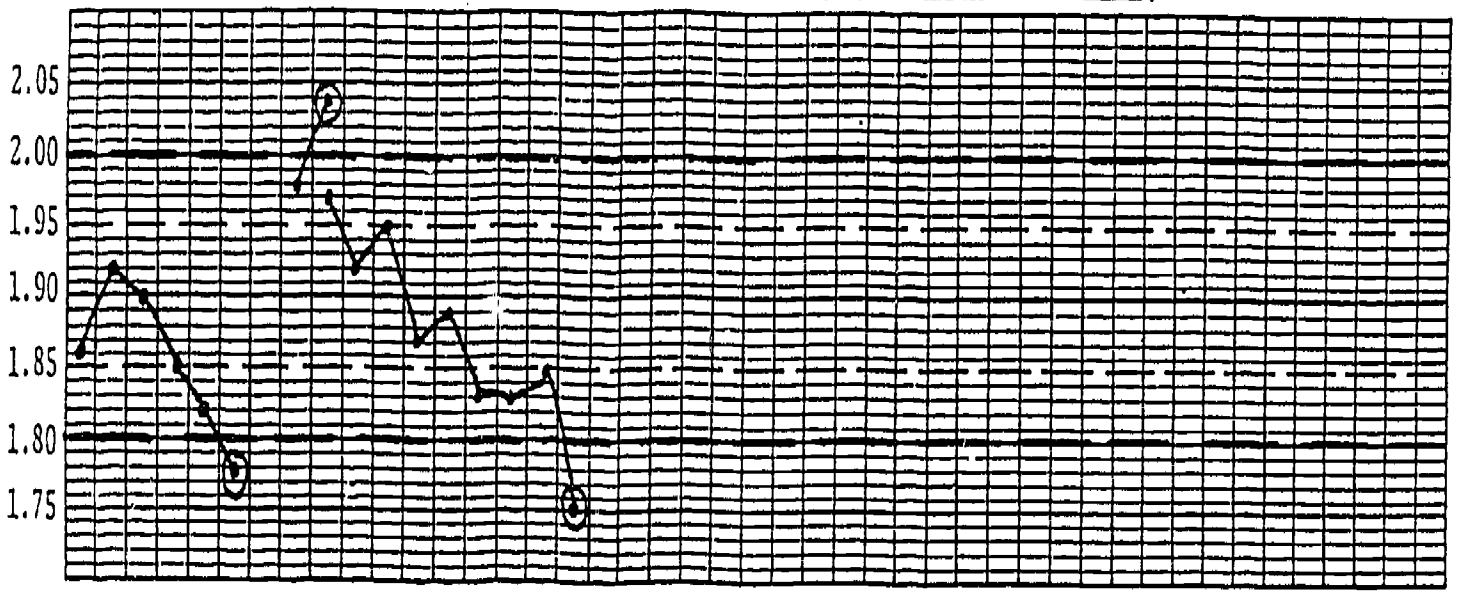
- OT - Other (comment)

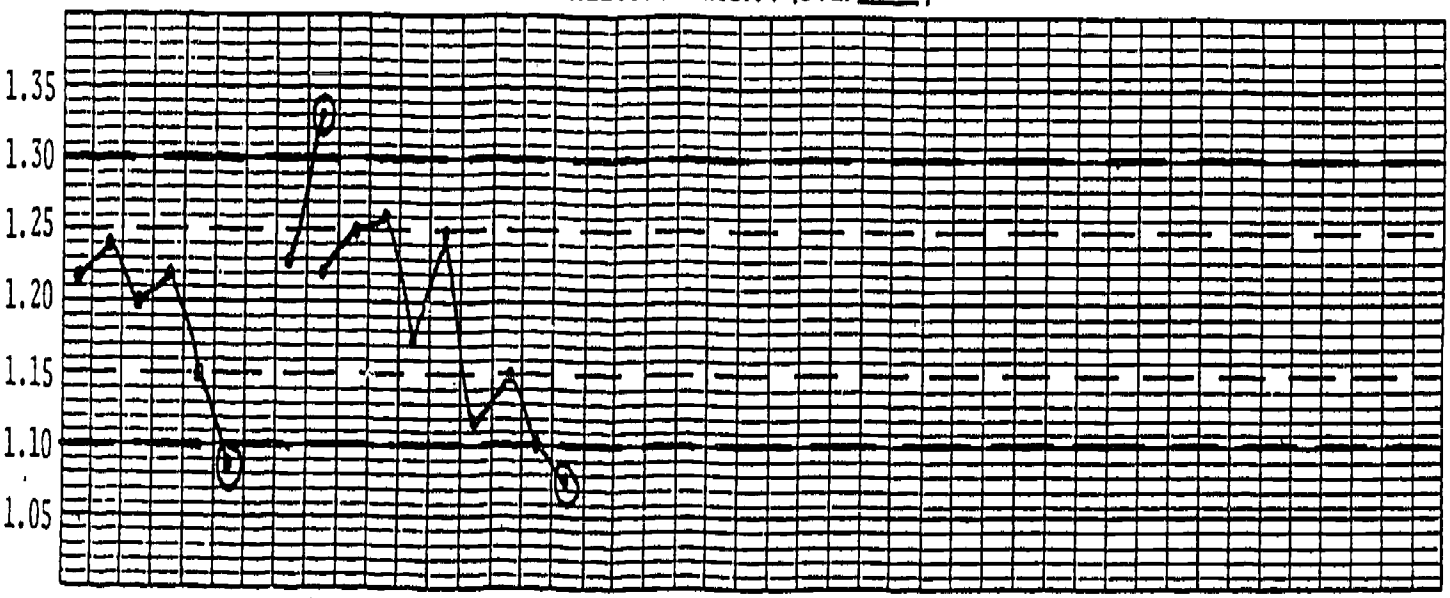
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27	30	30	31	31	1	1	2	2	3	3
TIME	9	4	9	4	9	4	8	4	9	4	9	4	9	4	10	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20	20	20	19	20	20	19	20	20	20	20	

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher Tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
4/3	4:20 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Under-replenishment.

CORRECTIVE ACTION: Increase replenishment rate and add enough replenisher directly to bring processor back within the control limits.

EXPLANATION: This is perhaps the most common recurrent problem. A gradual falloff trend can be seen in both the MD and DD, indicating a gradual reduction in development. As before, this is generally the earmark of improper replenishment causing a gradual decrease in developer strength, although over-diluted replenisher may bring similar results. In this case, an inadequate replenishment rate existed meaning that, on the average, each radiograph was using up more developer than was replaced via replenishment.

The proper corrective action is to increase the replenishment rate. Also, additional replenisher should be directly added to the processor developer tank (in approximately 100 ml increments) until the processing is again within control limits. This may be done by manually tripping the replenisher microswitches, by carefully pouring fresh developer directly into the developer tank using a container, or by running a few previously processed films.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
4/3	4:20 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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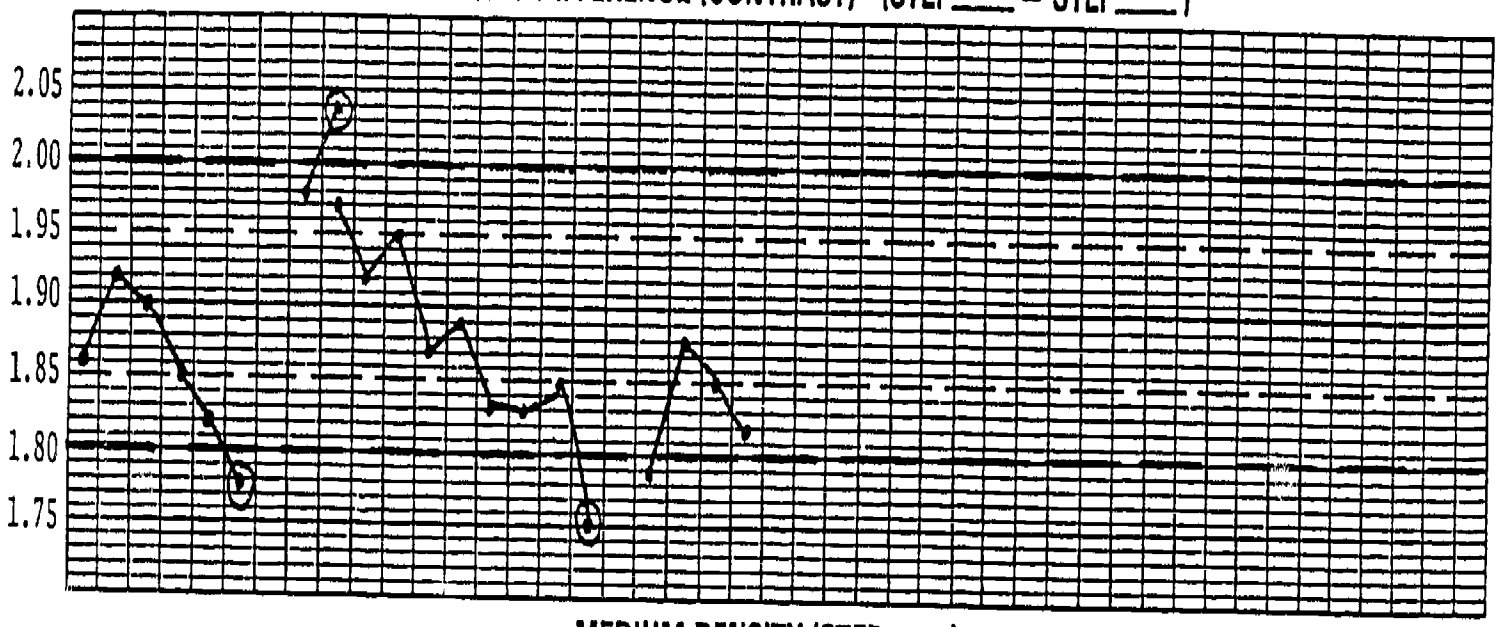
- OT - Other (comment)

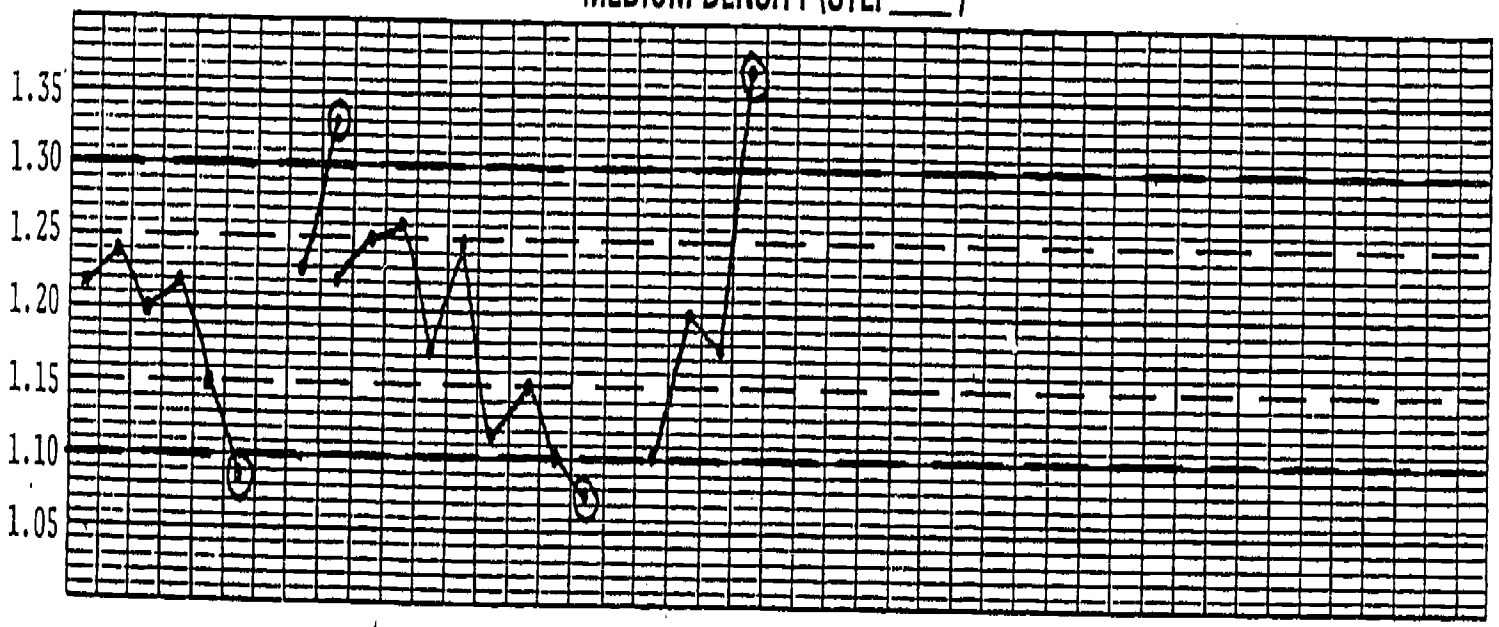
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27		30	30	31	31	1	1	2	2	3	3		6	6	7	7
TIME	9	4	9	4	9	4		8	4	9	4	9	4	9	4	10	4		9	4	9	3

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20		20	20	19	20	20	19	20	20	20	20		20	19	20	20	

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H_2O
4/3	4:20 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15W)
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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- OT - Other (comment)

ANSWER: Safe-light fogging.

CORRECTIVE ACTION: Replace safe-light bulb with one of the correct wattage.

EXPLANATION: The observation which suggests the existence of safe-light fogging in this example is the elevated MD with little or no change in the DD or B+F. The basis of this effect is that the small exposure increases caused by safe-light fogging result in much larger increases in optical density in the medium density (straight line region of the H&D curve) range than in the high (Shoulder) or low (Toe) density ranges. Figure 2 demonstrates this effect (1). Thus, the safe-light may result in no density increase at the B+F point, and the small increases in both points used to calculate DD (one around 0.5 O.D. and one around 2.5 O.D.) may cancel each other out leaving only the increase observed on the MD. Safe-light fogging may be quickly verified by simply making a second sensitometric strip with all safe-lights turned off.

In this instance, it was found that the hospital's maintenance crew had inadvertently replaced the 15 watt safe-light bulb with a 100 watt bulb. The problem disappeared following replacement.

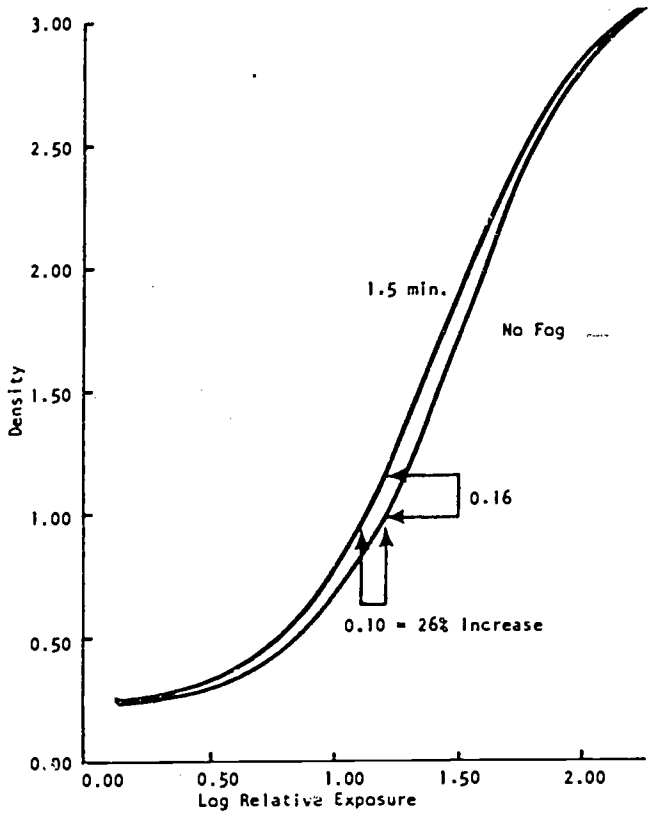

Figure 2. Effect of safe-light fogging on the H&D curve.

Note that the increase in density due to safe-light exposure is much greater for the medium density region around 1.0 O.D. where the MD index is taken. The increases around both points at which the contrast index (DD) is calculated are approximately equal and will therefore normally cancel out leaving the DD relatively unchanged. Observe that there is essentially no change in the base plus fog, although this area is usually checked for fog.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 pm	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
4/3	4:20 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15W)
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

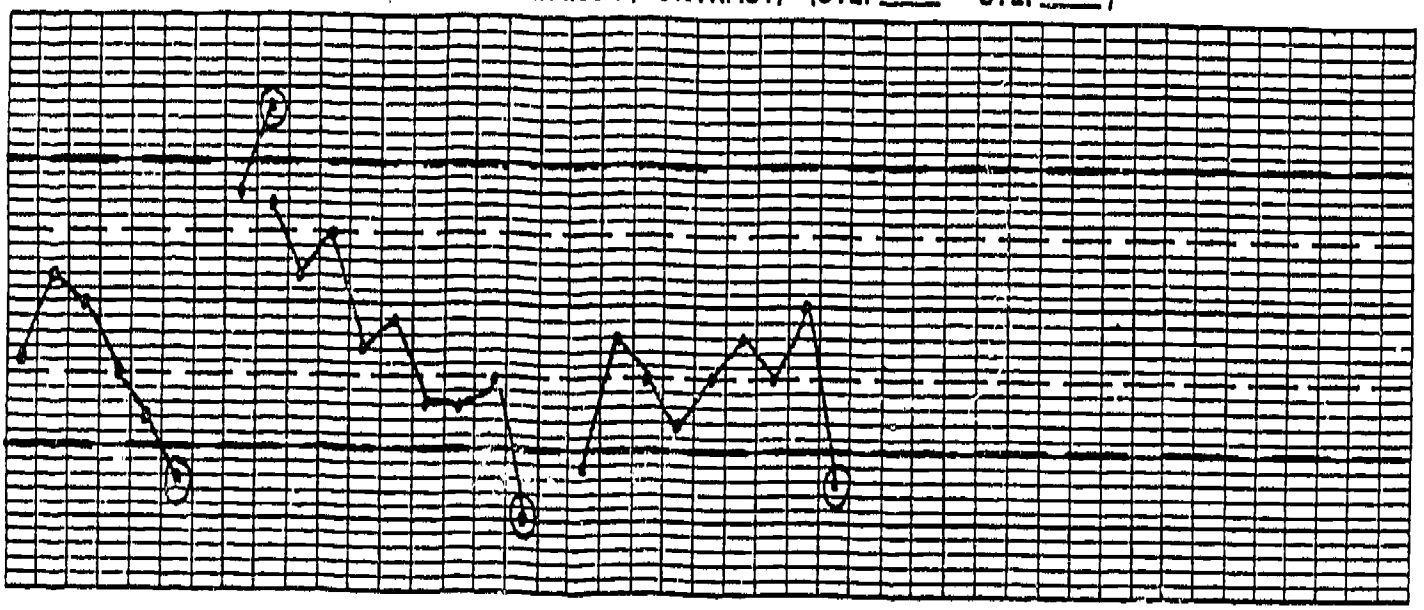
44

KEY:
CL - Cleaned
CC - Total Chemistry Change
CD - Changed Developer
CF - Changed Fixer
RI - Increased Replenishment Rate
RL - Lowered Replenishment Rate
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

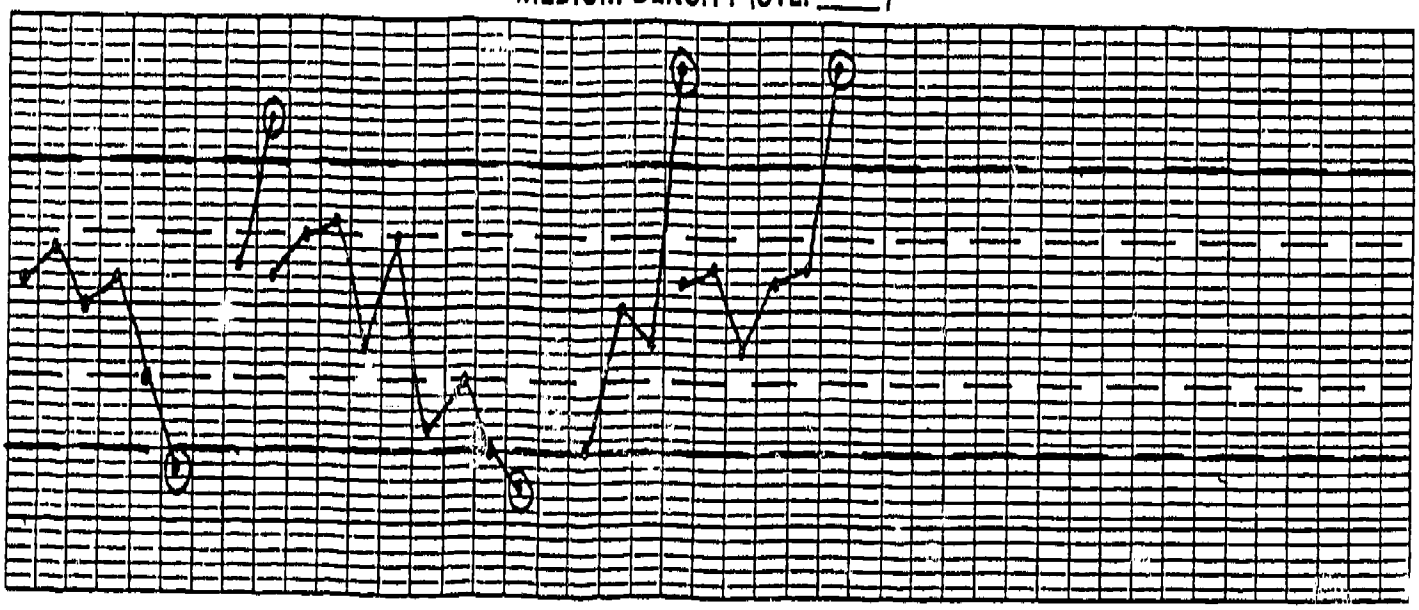
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27		30	30	31	31	1	1	2	2	3	3		6	6	7	7	8	8	9	9	10
TIME	9	4	9	4	9	4		8	4	9	4	9	4	9	4	10	4		9	4	9	3	9	3	10	3	9

DENSITY DIFFERENCE (CONTRAST) (STEP___ -- STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20		20	20	19	20	20	19	20	20	20	20		20	19	20	20	18	19	20	20	22	

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 pm	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H_2O
4/3	4:20 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15W)
4/10	9:15 am	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Developer thermostat set too high.

CORRECTIVE ACTION: Turn back thermostat setting until proper temperature is achieved.

EXPLANATION: It was stated earlier that changes or fluctuations in the developer temperature are not generally the result of an improper thermostat setting. In this case, however, the developer temperature was found to be excessiveiy high (93.5° as opposed to the proper 92°) and remained high, with no other possible cause being found. (Both the wash water temperature and pressure were normal and therefore not at fault. You must then assume that the thermostat setting has actually been changed, possibly as a result of unauthorized tampering.

Reset the thermostat and watch the developer temperature. If there is a recurrence, it may indicate the onset of thermostat malfunction, and must be checked out by a repairman.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O.
4/3	4:20 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15w)
4/10	9:15 (am) pm	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high.
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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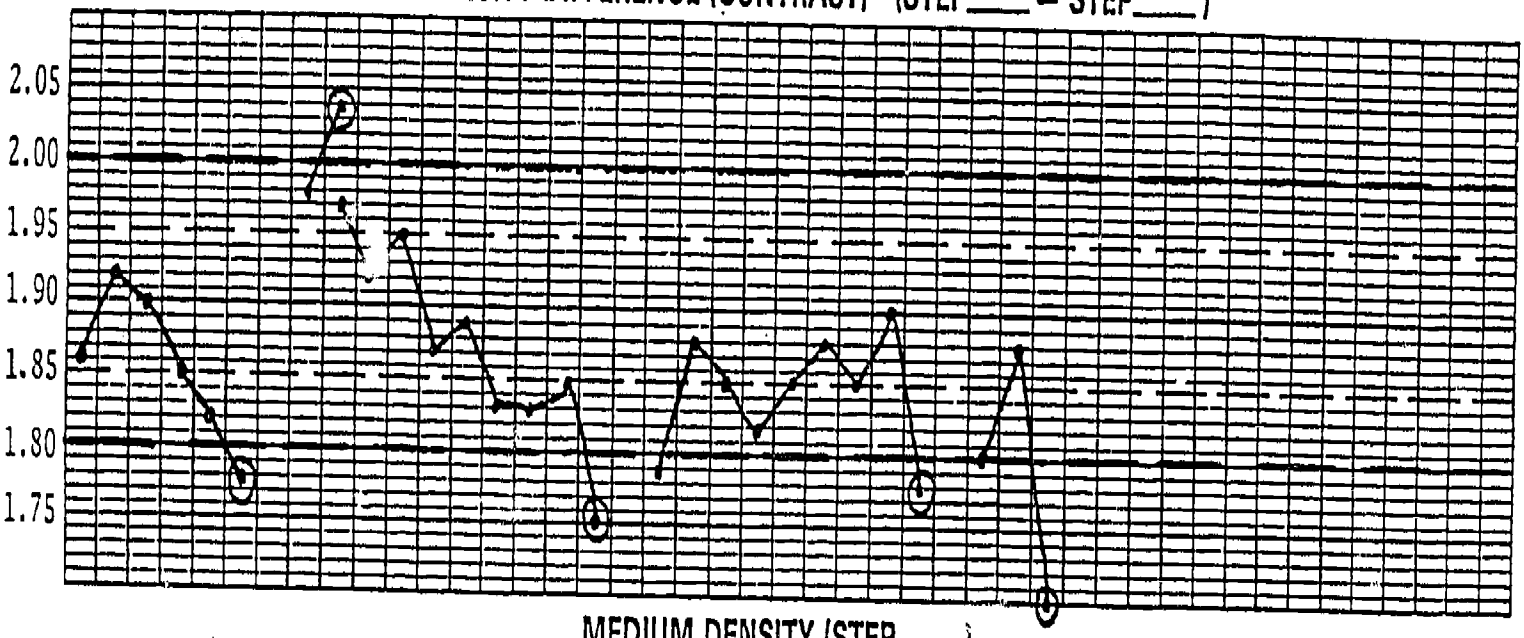
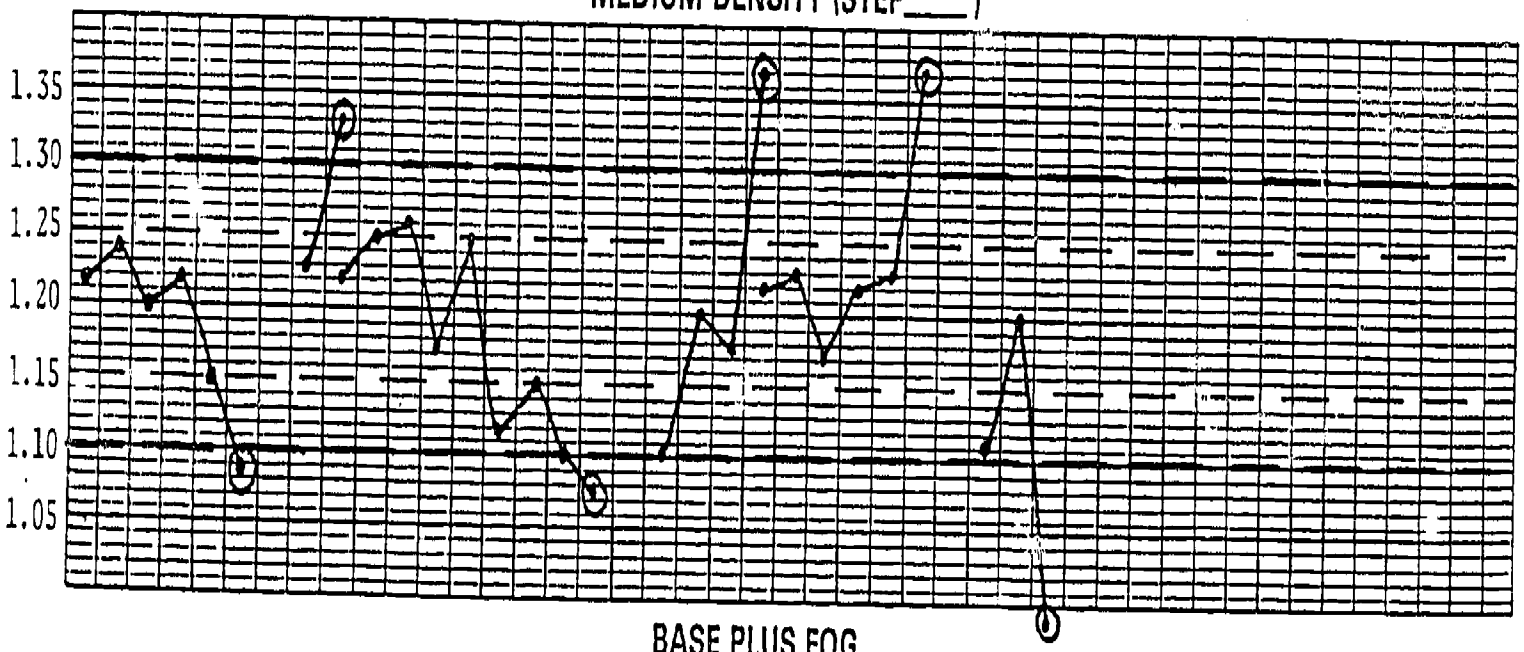
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27		30	30	31	31	1	1	2	2	3	3		6	6	7	7	8	8	9	9	10		13	13	14
TIME	9	4	9	4	9	4		8	4	9	4	9	4	9	4	10	4		9	4	9	3	9	3	10	3	9		9	3	9

DENSITY DIFFERENCE (CONTRAST) (STEP___ -- STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20		20	20	19	20	20	19	20	20	20	20		20	19	20	20	19	19	20	20	22		20	20	18

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
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3/29	6:00 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H_2O
4/3	4:20 am (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15w)
4/10	9:15 (am) pm	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high.
4/14	9:30 (am) pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Dev. Tanks Low - Lines pinched
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- MF - [illegible] New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Developer replenisher line pinched.

CORRECTIVE ACTION: Remove obstruction and refill developer tank.

EXPLANATION: There is not really any way to "diagnose" this particular problem from the sensitometric data alone. You will quickly discover it, however, by simply removing the lid to look at the processor. The point is that observations of the processor itself must not be overlooked in processing a QA problem. In this case, by observing the very low level in the developer tank, you would realize that a blockage might be preventing replenisher from reaching the processor. Since each film carries a signficant amount of developer out of the developer tank into the fixer, it would not take long to deplete the tank.

The correct procedure is to look for possible causes of the apparent blockage. In this case, a box of supplies had been accidently placed on top of the replenisher line, preventing replenishment from reaching the processor. Removing the object eliminates the problem.

Similar problems could also be caused by a clog somewhere in the line or by dirty or clogged filters.

ANSWER: Developer replenisher line pinched.

CORRECTIVE ACTION: Remove obstruction and refill developer tank.

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3/30	4:00	(pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr.-add 1 gal H_2O
4/3	4:20	(pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15	(pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15w)
4/10	9:15	(am)	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high
4/14	9:30	(am)	CL CC CD CF RI RL MD MF TD TW (MR) OT			Dev. Tanks Low - Lines pinched
4/15	6:00	(pm)	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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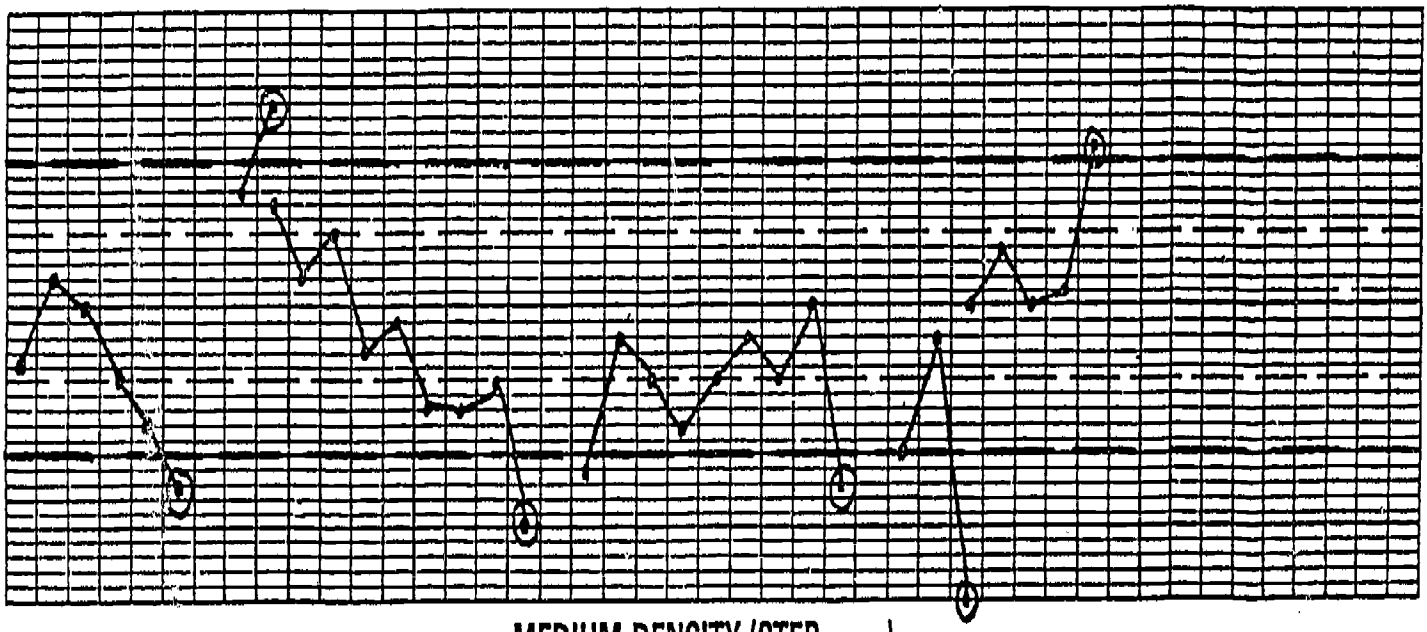
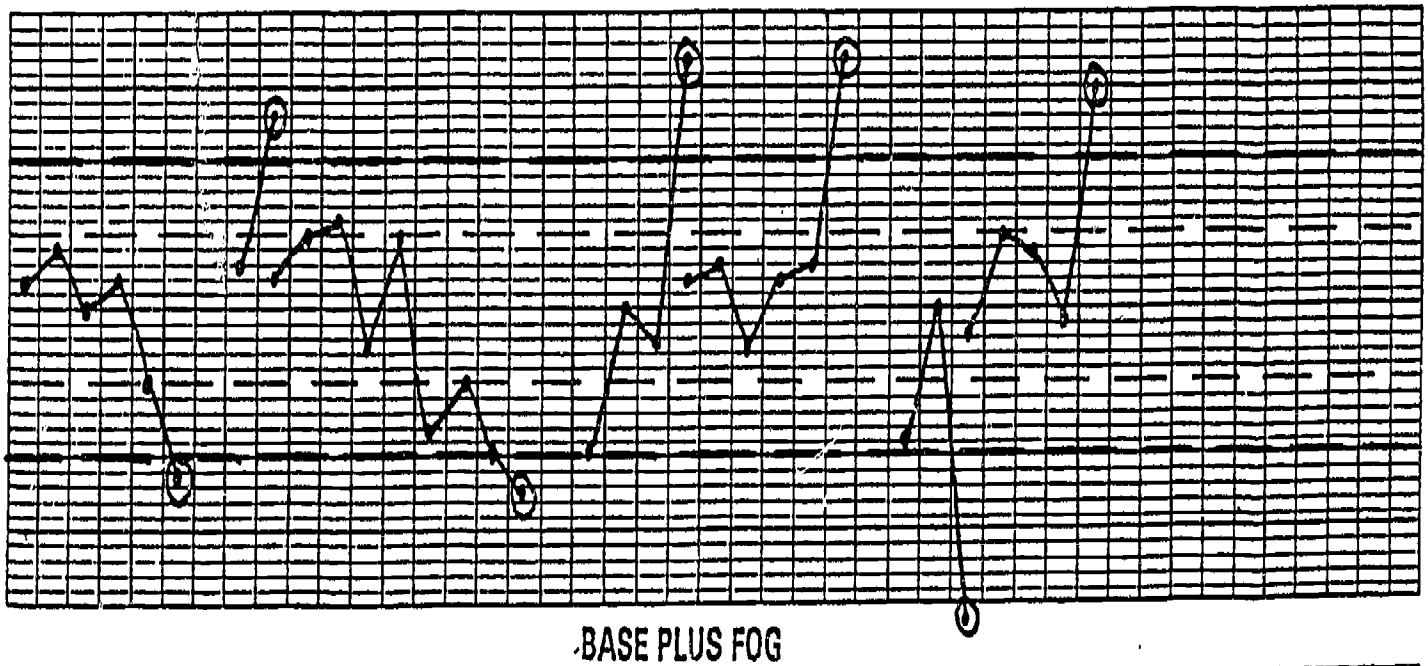
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27		30	30	31	31	1	1	2	2	3	3		6	6	7	7	8	8	9	9	10		13	13	14	14	15	15	16
TIME	9	4	9	4	9	4		8	4	9	4	9	4	9	4	10	4		9	4	9	3	9	3	10	3	9		9	3	9	4	9	4	10

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	20	19	20	19	20		20	20	19	20	20	19	20	20	20	20		20	19	20	20	19	19	20	20	22		20	20	18	19	20	20	23

D-MAX

53

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 pm	CL CC CD CF **RI** RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 pm	CL CC CD CF RI RL **MD** **MF** TD TW MR OT			Replenisher tanks Low
3/30	4:00 pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			Replen. to concentr.-add 1 gal H_2O
4/3	4:20 pm	CL CC CD CF **RI** RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			Replaced Safelight Bulb (15W)
4/10	9:15 am	CL CC CD CF RI RL MD MF **TD** TW MR OT	93.5°	92°	Devel. Temp. too high.
4/14	9:30 am	CL CC CD CF RI RL MD MF TD TW **MR** OT			Dev. Tanks Low - Lines pinched
4/15	6:00 pm	**CL** **CC** CD CF RI RL MD MF TD TW MR OT			Routine cleaning
4/16	10:05 am	CL CC CD CF RI RL MD MF TD TW MR **OT**			Forgot to add starter
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Did not add starter solution following chemistry change.

CORRECTIVE ACTION: Drain developer tank and restart with addition of proper amount of starter.

EXPLANATION: It is observed that shortly after a routine cleaning and chemistry change both the DD and MD are too high. Look immediately for a cause associated with this chemistry change (after, as usual, first seeing that the developer temperature is normal). Since new replenisher was not mixed, the problem must be limited to the developer in the processor. The most probable cause of the excessive chemical strength is failure to add sufficient (or any) starter solution when refilling the processor.* (Insufficient chemical strength found after a chemistry change would suggest contamination of the developer with fixer, as in an earlier example.)

It is again difficult to verify this cause unless the individual involved happens to remember. If you cannot, proceed with the draining and restarting of the processor without verification, being careful to add the proper amount of starter solution. If the assumption was correct, the problem should then disappear.

Although the frequency of this type of problem depends on how careful each facility's personnel is, it is generally a very good idea to make a sensitometric strip after every chemistry change to ensure that the proper level of processing is restored. In fact, it is a good idea to run a sensitometric strip after any maintenance or corrective activity on the processor, to ensure that proper processing is retained or restored.

*Adding starter solution is important to "age" the new developer to a strength found under normal use. If this is not done, then the strength of this "pure" developer cannot be maintained as bromide levels increase with use.

ACTIONS ON PROCESSOR

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3/27	4:05 am/(pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 am/(pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 am/(pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H2O
4/3	4:20 am/(pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 (am)/pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15w)
4/10	9:15 (am)/pm	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high.
4/14	9:30 (am)/pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Dev. Tanks Low - Lines pinched
4/15	6:00 (pm)/am	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
4/16	10:05 pm/am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Forgot to add starter
	pm/am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm/am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm/am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm/am	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm/am	CL CC CD CF RI RL MD MF TD TW MR OT			
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	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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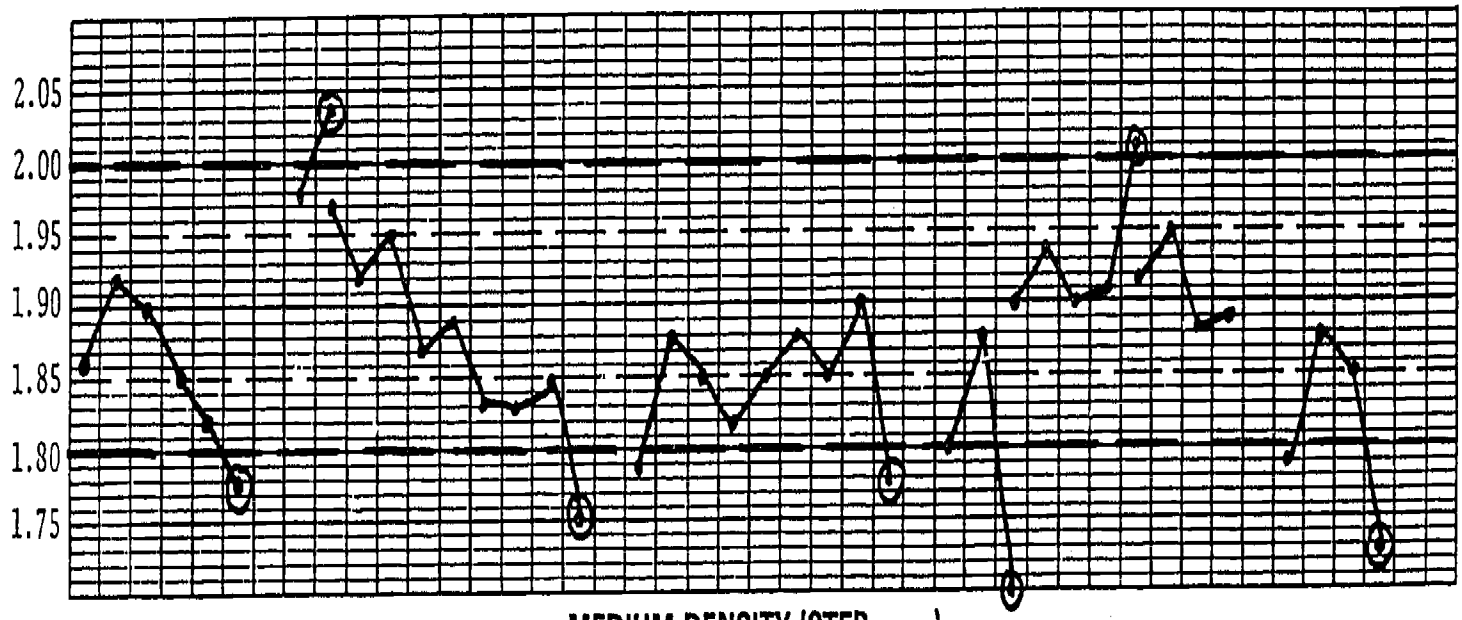
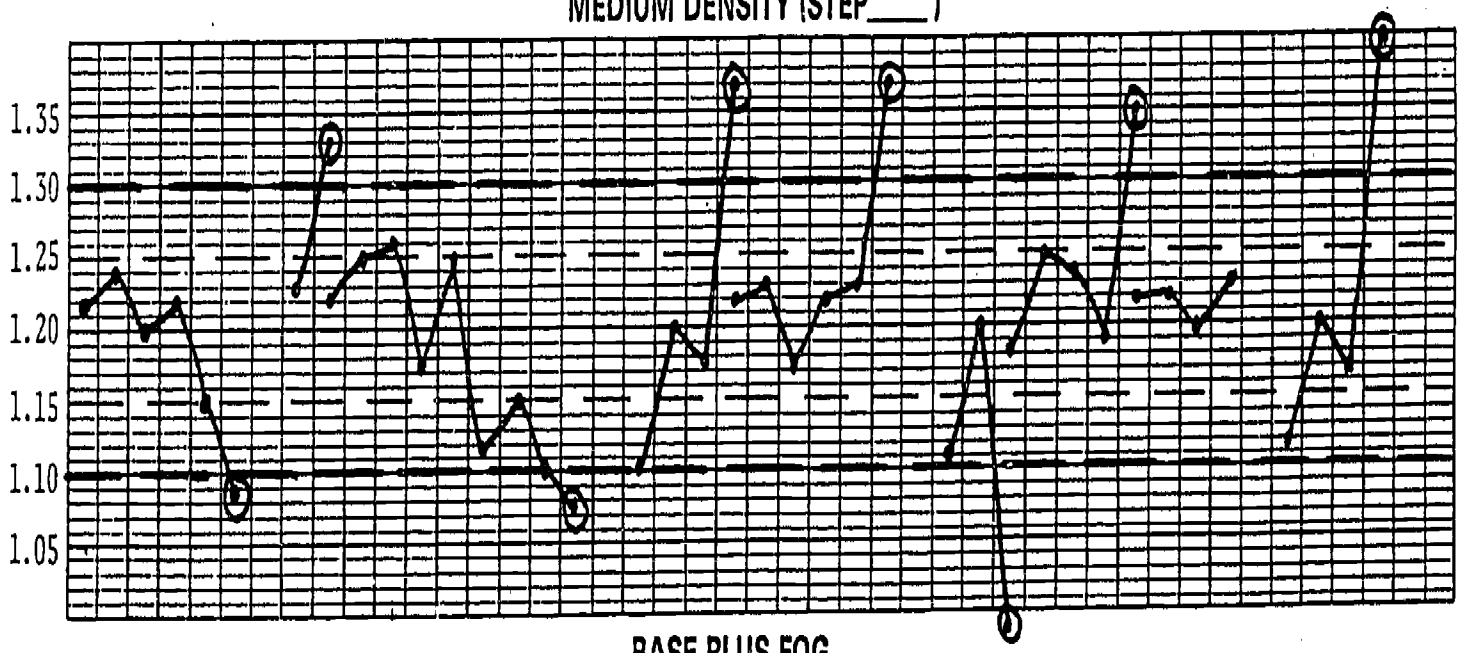
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH MARCH/APR

DATE	25	25	26	26	27	27		30	30	31	31	1	1	2	2	3	3		6	6	7	7	8	8	9	9	10		13	13	14	14	15	15	16	16	17	17		20	20	21	21		
TIME	9	4	9	4	9	4		8	4	9	4	9	4	9	4	10	4		9	4	9	3	9	3	10	3	9		9	3	9	4	9	4	10	4	9	4		9	3	9	3		

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

	20	20	19	20	19	20		20	20	19	20	20	19	20	20	20	20		20	19	20	20	19	19	20	20	22		20	20	18	19	20	20	23	20	20	20		19	20	20	29		

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H_2O
4/3	4:20 (pm)	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15W)
4/10	9:15 pm	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high.
4/14	9:30 pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Dev. Tanks Low - Lines pinched
4/15	6:00 (pm)	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
4/16	10:05 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Forgot to add starter
4/21	3:10 (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Film Bin Fogged - New Film
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY: CL - Cleaned
CC - Total Chemistry Change
CD - Changed Developer
CF - Changed Fixer
RI - Increased Replenishment Rate
RL - Lowered Replenishment Rate
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: Film in film bin fogged.

CORRECTIVE ACTION: Eliminate sources of fogging and replace film.

EXPLANATION: The extremely high base plus fog immediately suggests some form of film fogging. (Although high developer temperature can cause this amount of fogging, it is normally accompanied by much greater changes in density difference and medium density.) To determine the source of fogging, the following tests may be performed:

(1) Process several sheets from various parts of the bin (including the contr[illegible]ox) with all safe-lights off.

(2) Perform the test for darkroom fogging described in the manual: if neither indicated darkroom fogging, then the problem has been narrowed down to the film itself.

(3) Run a sheet of film from a new box. If there is still fog on the film, refer to the section on proper film handling and storage in the manual. If there is no fog, then the problem is only with the film in the bin.

Although the cause could be in the film itself (bad or outdated), look for some external source of radiation.* In this example it was found that some radioactive material was temporarily stored in an adjacent room near the bin.

*The cause of light-fogged film bin is usually indicated by the telltale pattern of low B & F at the bottom of the boxes and high density at the top, where exposure to the light is greatest.

The ruined film which is removed from the bin should be kept for use as processor clearing film or to use as "fully exposed" film in correction actions.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
3/27	4:05 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.75	.80	
3/29	6:00 pm	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Replenisher tanks Low
3/30	4:00 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. to concentr. - add 1 gal H_2O
4/3	4:20 pm	CL CC CD CF (RI) RL MD MF TD TW MR OT	.80	.85	
4/7	3:15 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replaced Safelight Bulb (15W)
4/10	9:15 am	CL CC CD CF RI RL MD MF (TD) TW MR OT	93.5°	92°	Devel. Temp. too high.
4/14	9:30 pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Dev. Tanks Low. Lines pinched
4/15	6:00 pm	(CL) (CC) CD CF RI RL MD MF TD TW MR OT			Routine Cleaning
4/16	10:05 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Forgot to add starter
4/21	3:10 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Film Bin Fogged - New Film
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY: CL - Cleaned
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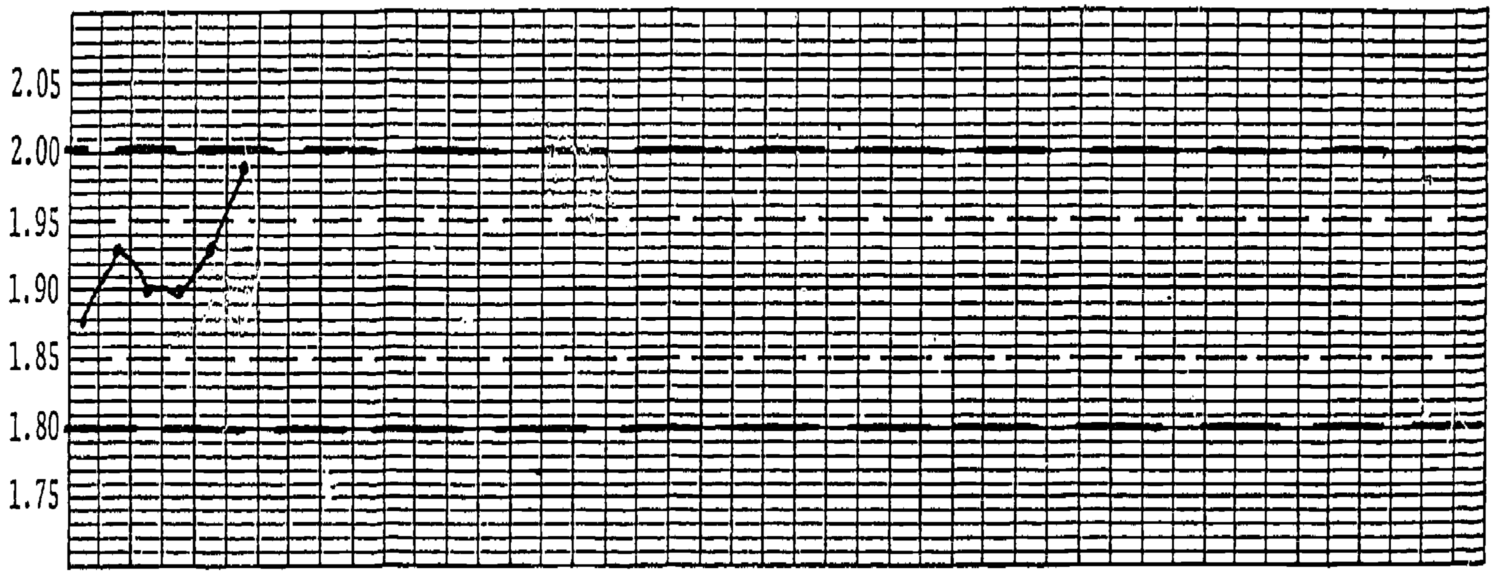
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

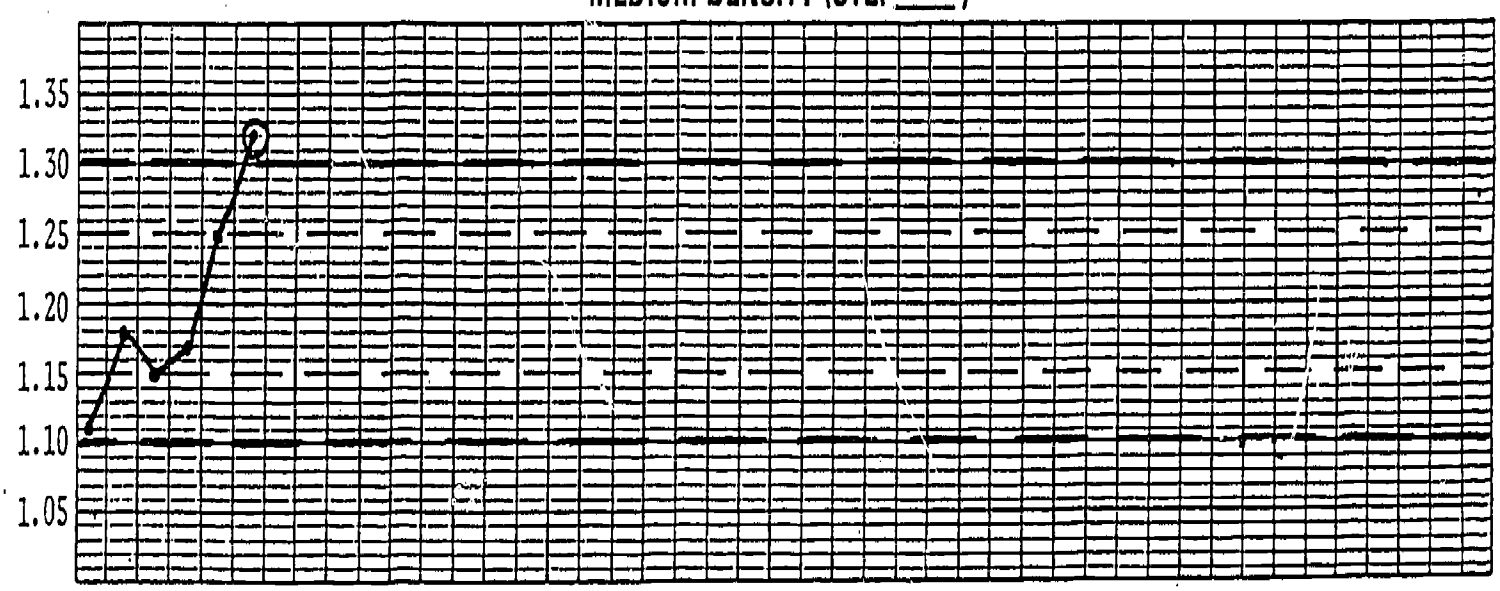
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR

DATE	22	22	23	23	24	24
TIME	9	3	9	3	9	3

DENSITY DIFFERENCE (CONTRAST) (STEP____ – STEP____)



MEDIUM DENSITY (STEP____)



BASE PLUS FOG

20	19	19	20	20	20	20

D-MAX

61

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: Replenishment rate too high.

CORRECTIVE ACTION: Lower replenishment rate and run several fully exposed films.

EXPLANATION: As in earlier examples, this problem is indicated by the gradual upward trend observed in the Medium Density plot, although the trend in this case is not quite as clear as before and is only seen in the MD region. This does not mean that the apparent over-replenishment has only affected the MD, but that the effect on the DD has probably been masked to some extent by random (i.e., inherent) fluctuations.

The proper corrective action, as before, is to readjust downward the replenishment rate and run a few fully exposed films to bring the processor back to within control limits.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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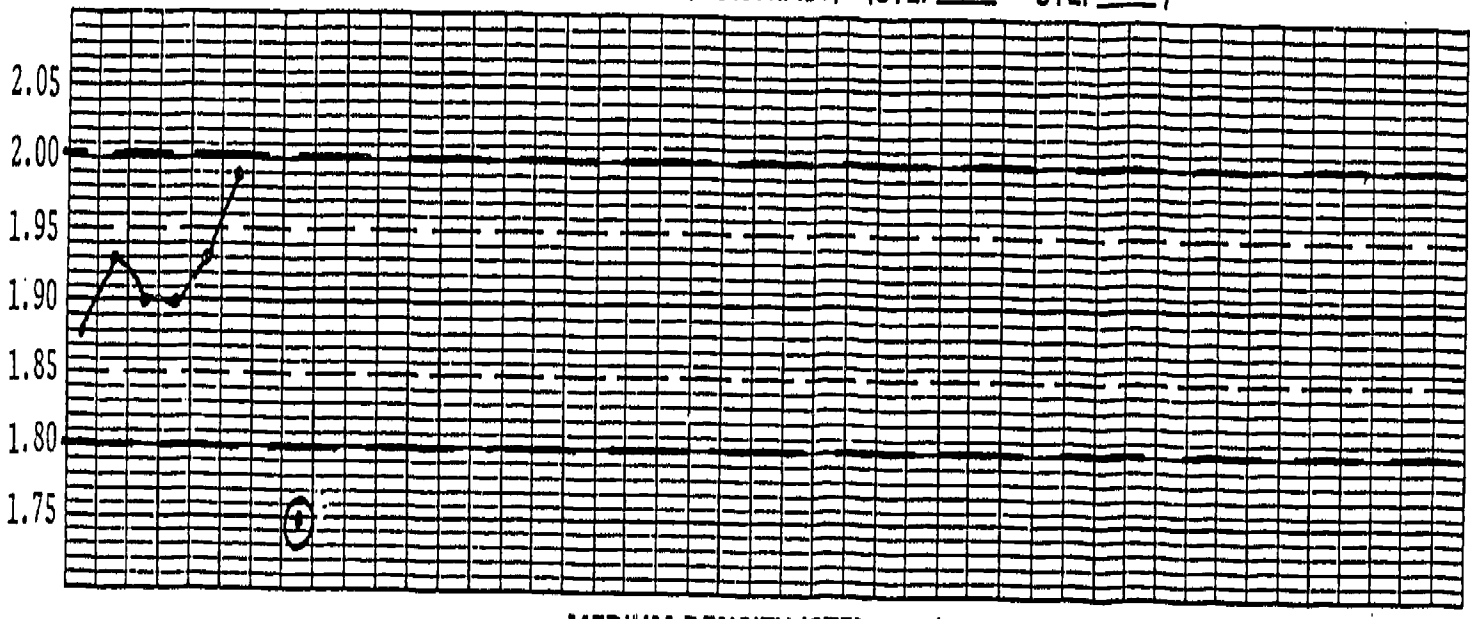
- MD - Mixed New Developer Replen.
- MF - Mixed New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

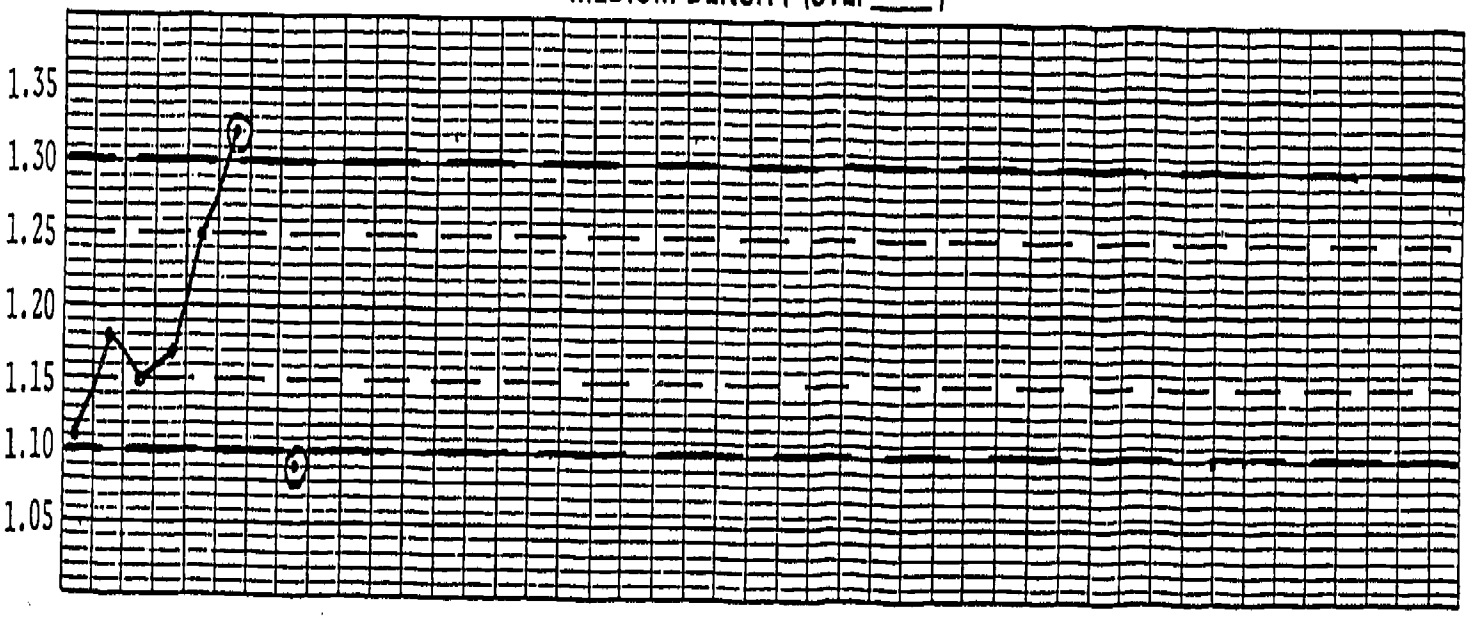
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR

DATE	22	22	23	23	24	24	27
TIME	9	3	9	3	9	3	8

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	19	20	20	20	19

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100ml replen.
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY:
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- MF - Mixed New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Chemical oxidation.

CORRECTION ACTION: Add fresh developer directly to processor developer tank.

EXPLANATION: This is another example of the reduction in developer strength that can occur over an extended period of low-volume processing as a result of interaction of the chemistry with the atmosphere (oxidation and evaporation). You will again observe that the effect is more pronounced in the DD plot than in the MD due to the faster oxidation of hydroquinone.

The proper corrective action is to add fresh developer directly to the processor developer tank by the methods prevously described until acceptable processing levels are restored.

Three important points must be emphasized, however, for the proper evaluation and correction of this common occurrence.

(1) If the processor was shut down (e.g., over the weekend) then sufficient time must be allowed for the processor to reach proper operating temperature before a sensitometric strip is run. If this is not done, then the sensitometric indication of low development may be the result of low temperature rather than from oxidation.

(2) If the period of low-volume processing was unusually long (i.e., after a holiday weekend), the oxidation effect may be much more severe than is shown here. If this is the case, dump the developer and restart the processor rather than try to correct it by adding fresh developer.

(3) Most important, oxidation in the developer tank is primarily the result of its elevated temperature (over 90°). If the processor must be left running during low-volume periods (such as weekends) then a "stand-by" system would be a good investment. These systems maintain the processor in an "on" conditon, but reduce the water flow and hold the developer several degrees below its operating temperature. When taken off "stand-by" condition, the developer is quickly brought up to its operating temperature. These systems usually conserve a significant amount of water and electricity during low-volume periods, and the reduced temperature greatly reduces chemical oxidation.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100ml replen.
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY:
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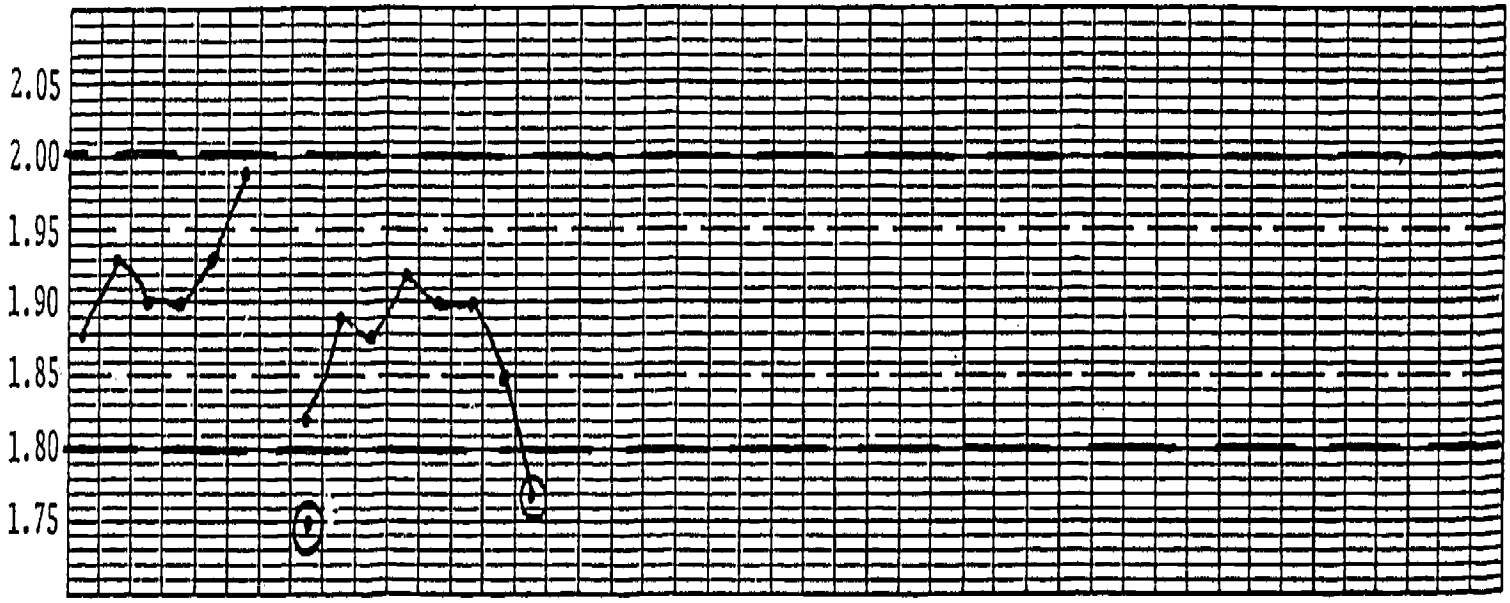
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

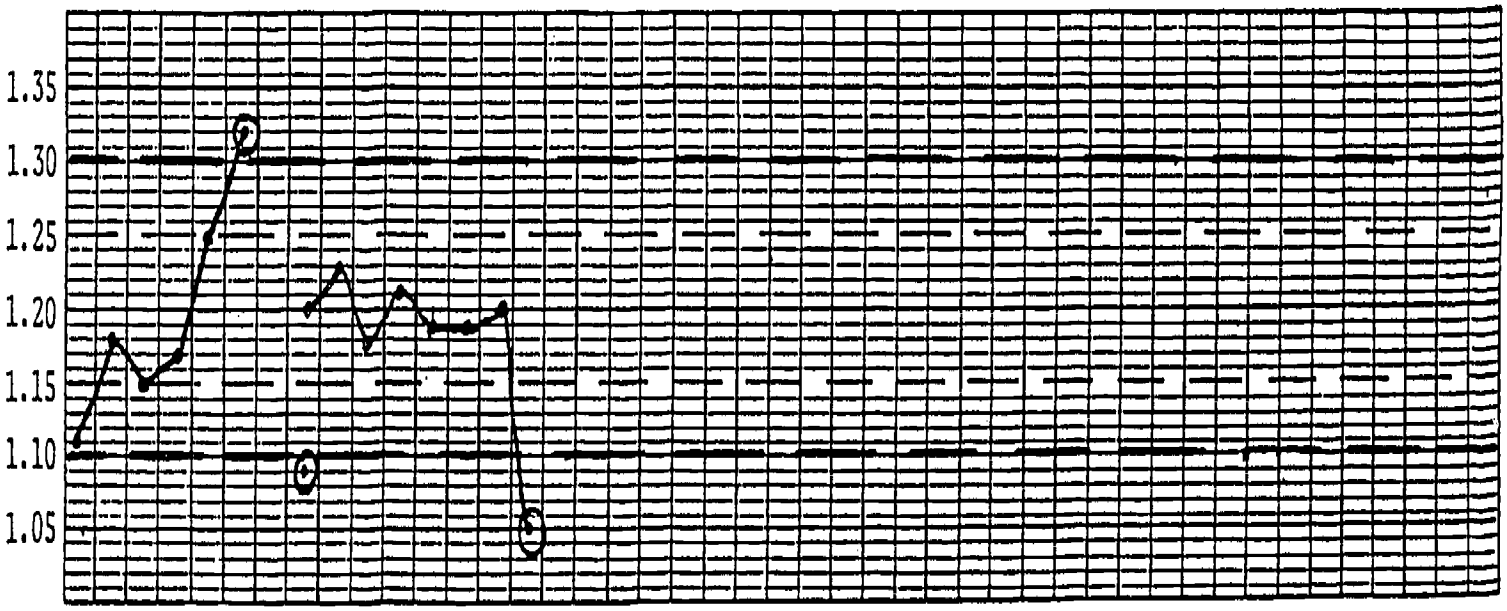
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR

DATE	22	22	23	23	24	24		27	27	28	28	29	29	30	30
TIME	9	3	9	3	9	3		8	4	9	4	9	3	9	4

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	19	20	20	20		19	20	20	19	19	20	20	19	

D-MAX

ACTIONS ON PROCESSOR

Date	Time		Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10	am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05	(am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100ml replen.
4/30	4:00	am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100ml Replen - Reason unknown
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: Cause unknown.

CORRECTIVE ACTION: Add fresh developer until processor is back to within the control limits.

EXPLANATION: Although it may appear that this exercise was to "trick" the reader, the moral of this example is important: if the cause of a problem cannot be found within a reasonable period of time (20-30 minutes), stop looking and just correct the problem. Although it is certainly desirable to "solve" all sub-optimum processing problems, it must be kept in mind that the processor is an important link in a normally busy clinical environment. Thus, the processor should not be tied up for too long a time in searching out the source of the problem. The problem should be remedied by the appropriate corrective action (in this case the addition of fresh developer to increase developer strength) and the processing observed for a possible recurrence. if it does not recur, then the problem's source was of no consequence. If there is a recurrence, then that is the proper time to spend more effort in locating the cause.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 **pm**	CL CC CD CF RI **RL** MD MF TD TW MR OT	.80	.75	
4/27	8:05 **am**	CL CC CD CF RI RL MD MF TD TW MR **OT**			oxidation - add 100 ml Replen.
4/30	4:00 **pm**	CL CC CD CF RI RL MD MF TD TW MR **OT**			Add 100 ml Replen - Reason unknown
5/4	5:30 **pm**	CL CC CD CF RI RL **MD** **MF** TD TW MR OT			Tanks Low
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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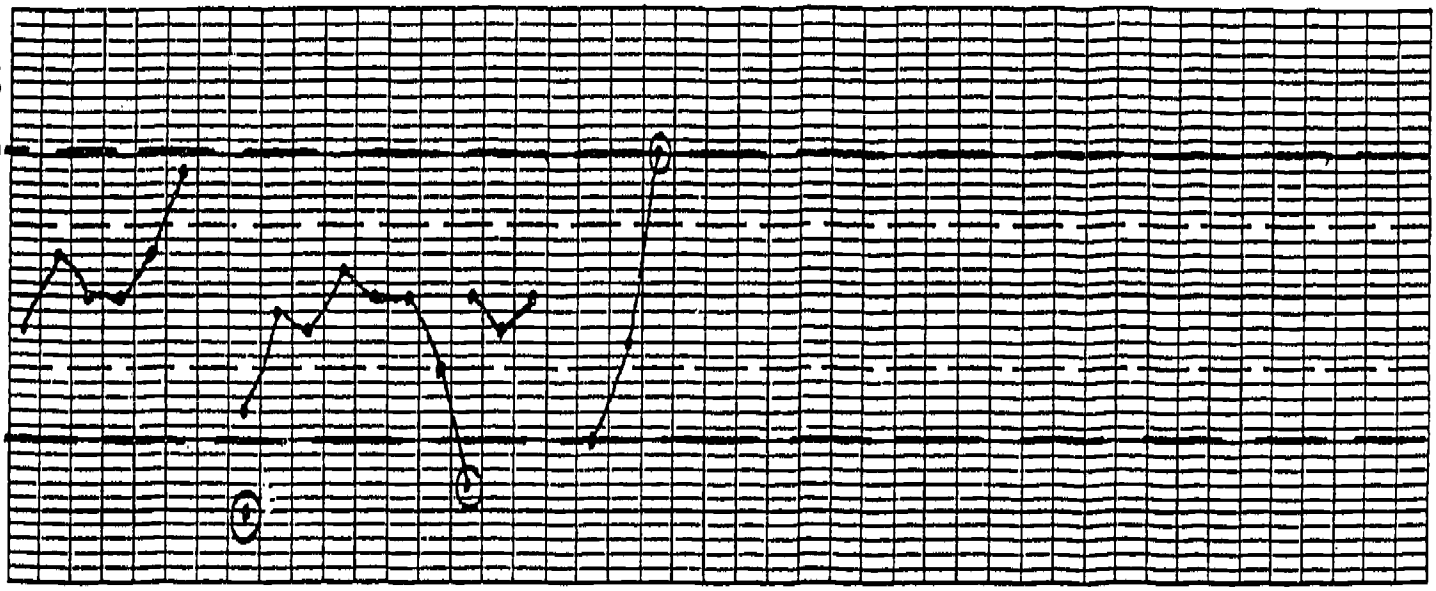
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

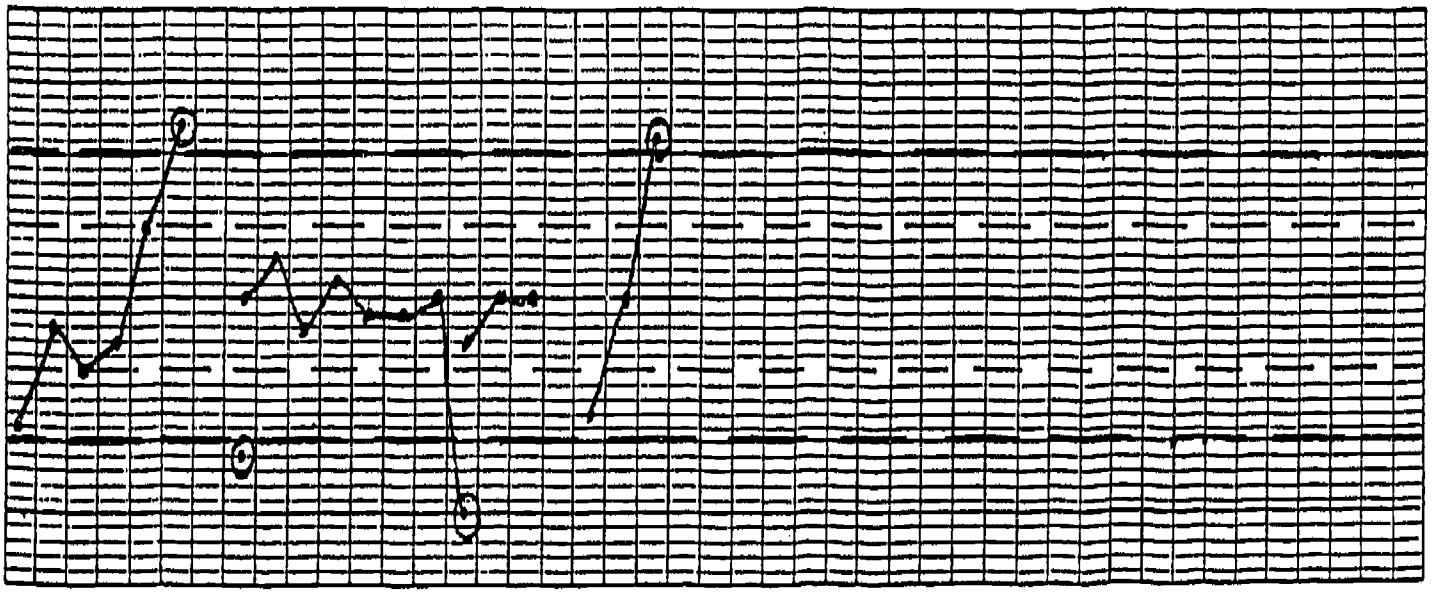
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR/MAY

DATE	22	22	23	23	24	24		27	27	28	28	29	29	30	30	1	1		4	4	5
TIME	9	3	9	3	9	3		8	4	9	4	9	3	9	4	10	4		8	4	8

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	19	20	20	20		19	20	20	19	19	20	20	19	20	20		19	20	20	

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 pm	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 am	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100 ml replen.
4/30	4:00 pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100 ml Replen - Reason unknown
5/4	5:30 pm	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Tanks Low
5/5	8:30 am	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. improp. mixed - dilute
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

ANSWER: Replenishment too concentrated.

CORRECTIVE ACTION: Dilute replenisher with water until proper specific gravity is reached.

EXPLANATION: This is another example of a problem encountered in an earlier exercise. The sensitometric indication of high MD and OD was found shortly after a new batch of developer replenisher was mixed. Thus, after first determining that the developer temperature was normal, the next thought should be in the direction of the replenisher tank. A specific gravity test quickly indicates insufficient dilution.

As before, additional water should then be slowly mixed in until the correct specific gravity is obtained. An important point to remember when mixing new developer replenisher is that it is easy to add more water to get the right specific gravity, but it is impossible to take out. Therefore, somewhat less water should be added when doing the dilution than is called for, followed by a specific gravity measurement. Then, more water can be slowly mixed in if required until the right dilution is reached as indicated by the specific gravity. This "ounce of prevention" can eliminate several incidences of improper processing which would require throwing out an entire tank of developer.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am **pm**	CL CC CD CF RI **RL** MD MF TD TW MR OT	.80	.75	
4/27	8:05 **am** pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			Oxidation - add 100 ml Replen.
4/30	4:00 am **pm**	CL CC CD CF RI RL MD MF TD TW MR **OT**			Add 100 ml Replen - Reason unknown
5/4	5:30 am **pm**	CL CC CD CF RI RL **MD** **MF** TD TW MR OT			Tanks Low
5/5	8:30 **am** pm	CL CC CD CF RI RL MD MF TD TW MR **OT**			Replen. improp. mixed - dilute
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

KEY:
CL - Cleaned
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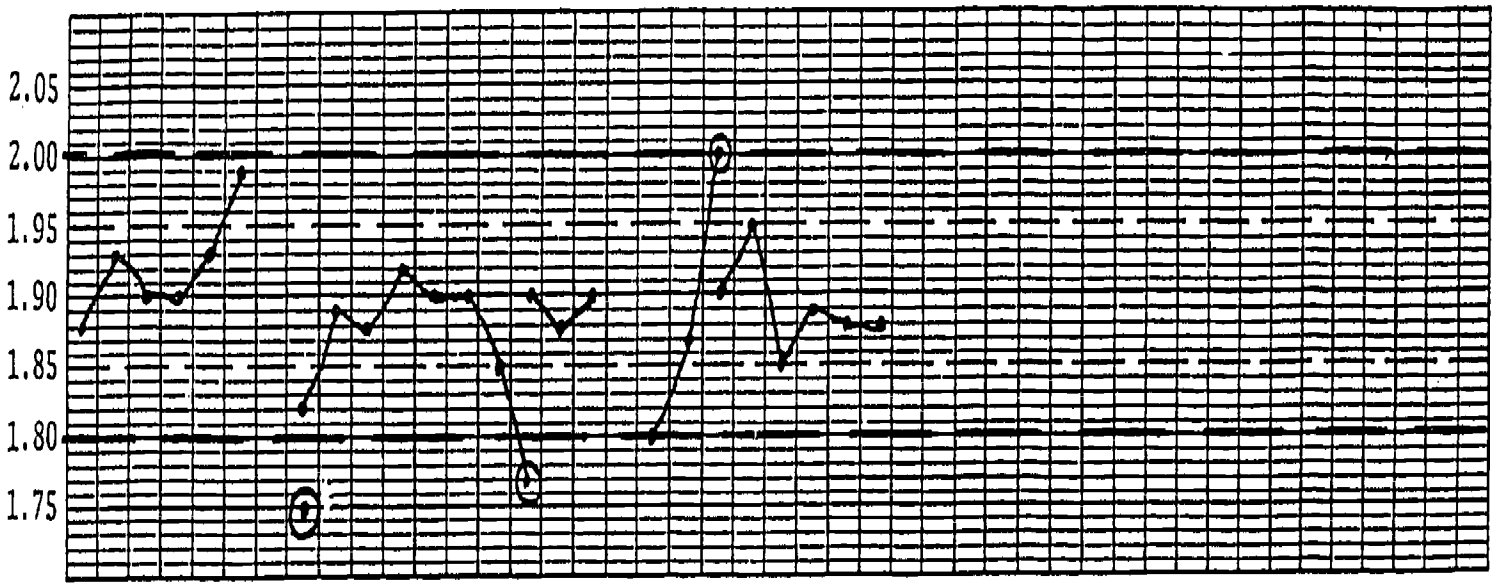
RI - Increased Replenishment Rate
RL - Lowered Replenishment Rate
MD - Mixed New Developer Replen.
MF - Mixed New Fixer Replen.
TD - Developer Temperature Adjust.
TW - Water Temperature Adjust.
MR - Mechanical Repair
OT - Other (comment)

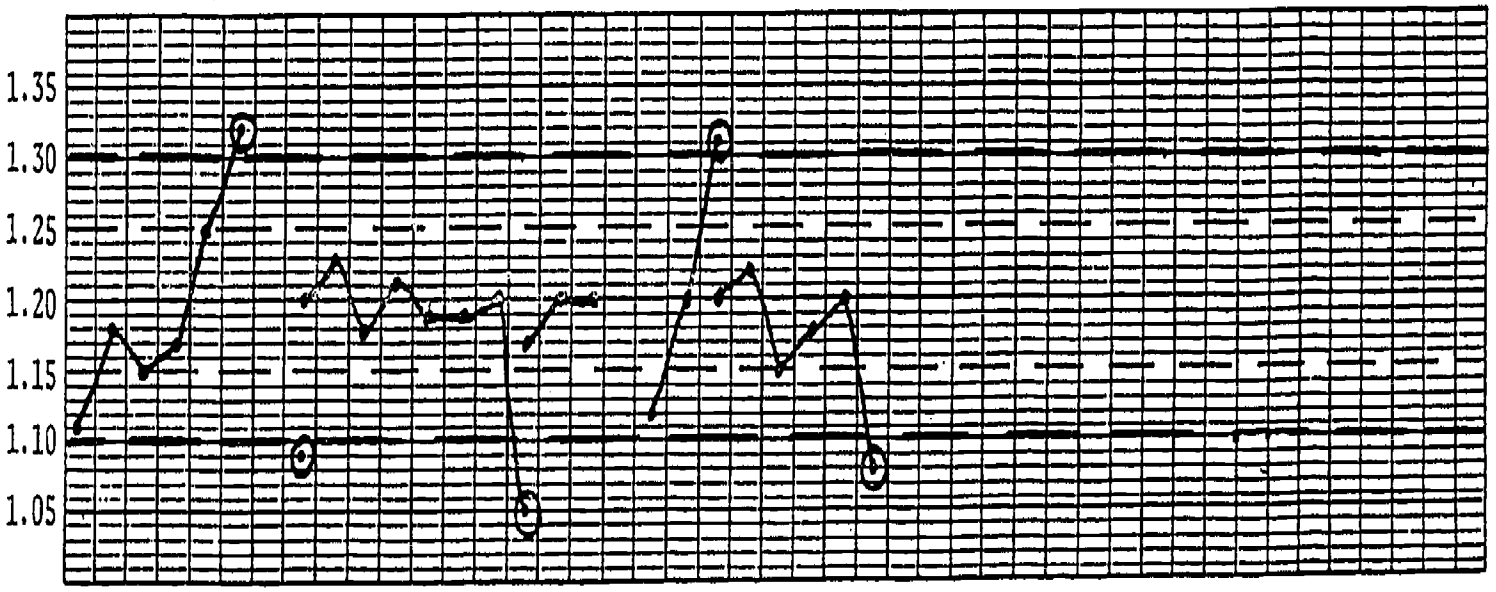
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR/MAY

DATE	22	22	23	23	24	24		27	27	28	28	29	29	30	30	1	1		4	4	5	5	6	6	7	7
TIME	9	3	9	3	9	3		8	4	9	4	9	3	9	4	10	4		8	4	8	3	9	3	9	3

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	19	20	20	20		19	20	20	19	19	20	20	19	20	20		19	20	20	20	20	19	20	19	

D-MAX

ACTIONS ON PROCESSOR

Date	Time		Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10	am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05	(am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Oxidation - add 100 ml Replen.
4/30	4:00	am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100 ml Replen - Reason unknown
5/4	5:30	am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Tanks Low
5/5	8:30	(am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. improp. mixed - dilute
5/7	3:05	am pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			1st strip not from control box
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
		am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: First sensitometric strip not from control box.

CORRECTIVE ACTION: None.

EXPLANATION: The lesson of this exercise is that it is important to verify a processor change before searching out a processor-related case. This verification consists of nothing more than making a second sensitometric strip to see if the change is still evident. In this case, the second strip was normal. It was then realized that the first strip was erroneously made on a sheet of film not taken from the control box.* The observed change was due to differences in the film and not related to the processor at all.

Other similar "anomalous" sensitometric exposures may be due to momentary electric "surges" through the sensitometer during exposure, as an example. A single additional sensitometric strip will uncover most such situations, and save searching out a nonexistant processing problem.

*There is a fair amount of legitimate feeling that control film should not be kept in the film bin, this example being one such reason. If it is not kept in the bin, small amounts of it should be kept in a light-tight film carrying case, the rest kept refrigerated until needed. There is, however, at least one reason for keeping it in the bin: it will be subject to the same conditions as the regular film, and resulting environmental problems will be evidenced in the control strips which may otherwise go unnoticed for a length of time. If kept in the film bin, the control film must be readily distinguished from the rest either by keeping it in its box with the top replaced, or by keeping it in its bag with flap folded over.

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100 ml Replen.
4/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100 ml Replen - Reason unknown
5/4	5:30 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Tanks Low
5/5	8:30 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. improp. mixed - dilute
5/7	3:05 am pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			1st strip not from control box
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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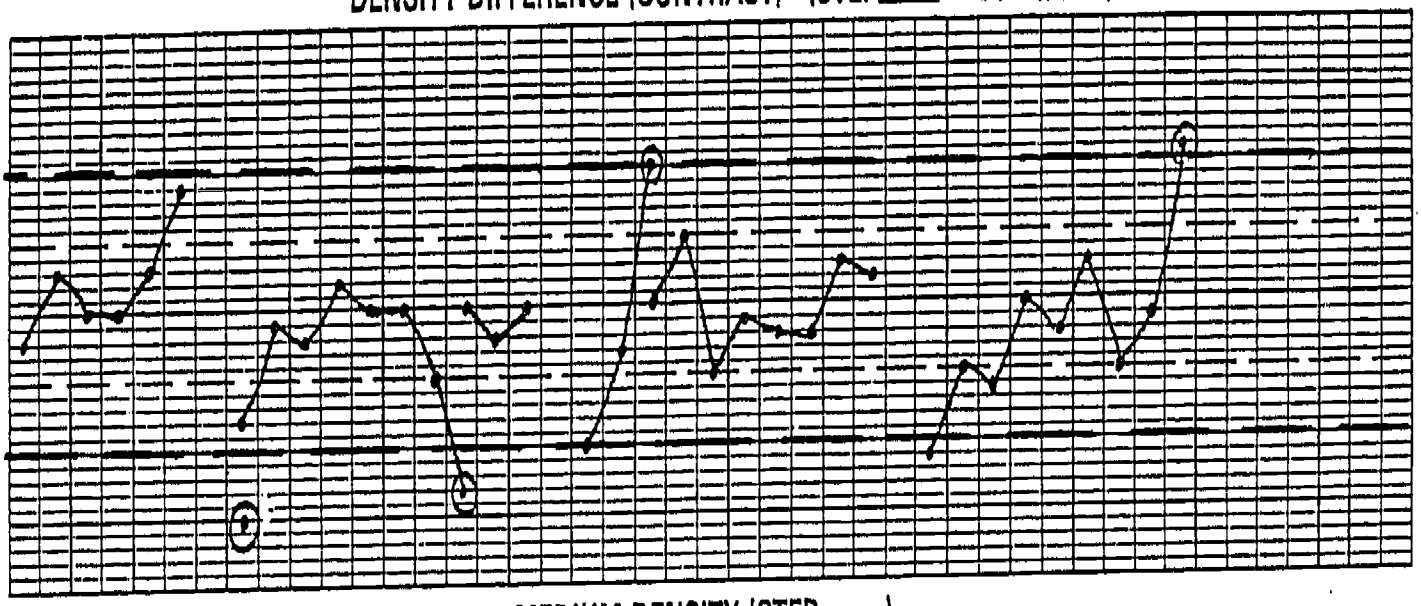
- MF - Mixed New Fixer Replen.
- TD - Developer Temperature Adjust.
- TW - Water Temperature Adjust.
- MR - Mechanical Repair
- OT - Other (comment)

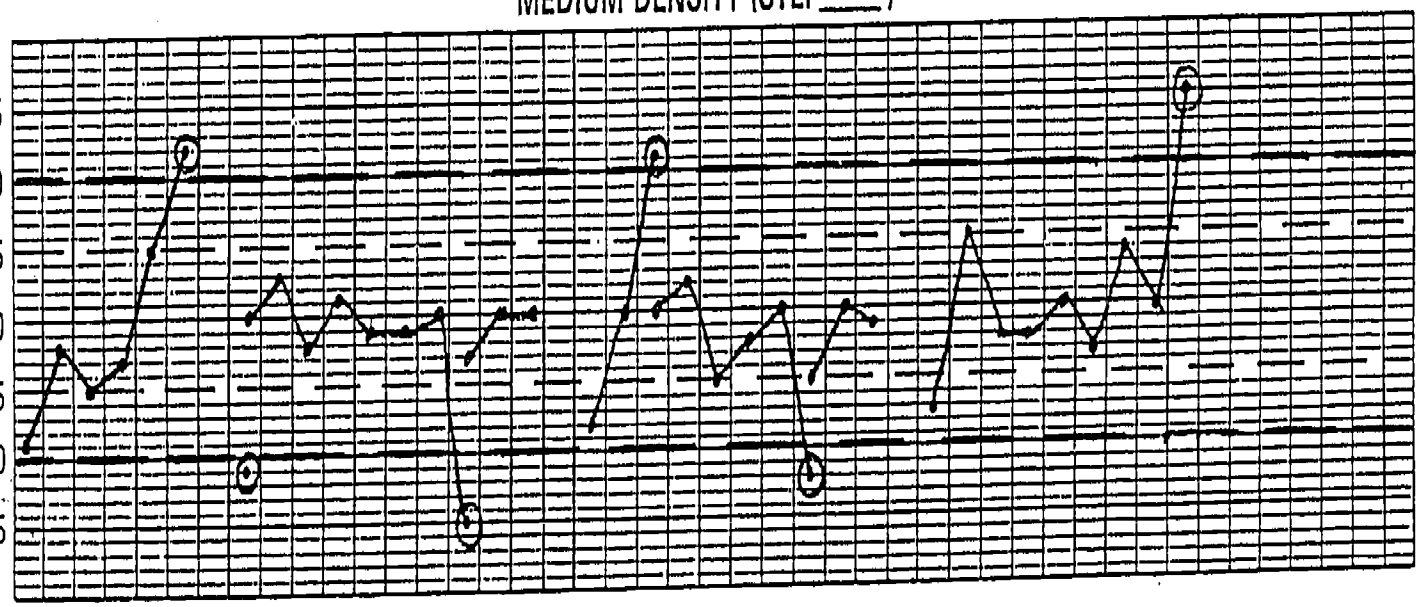
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR/MAY

DATE	22	22	23	23	24	24		27	27	28	28	29	29	30	30	1	1		4	4	5	5	6	6	7	7	8	8		11	11	12	12	13	13	14	14	15
TIME	9	3	9	3	9	3		8	4	9	4	9	3	9	4	10	4		8	4	8	3	9	3	9	3	9	3		9	4	9	4	9	4	10	4	9

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

20	19	19	20	20	20		19	20	20	19	19	20	20	19	20	20		19	20	20	20	20	19	20	19	20	20		19	19	20	20	20	20	19	20	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am **(pm)**	CL CC CD CF RI **(RL)** MD MF TD TW MR OT	.80	.75	
4/27	8:05 **(am)** pm	CL CC CD CF RI RL MD MF TD TW MR **(OT)**			oxidation - add 100 ml replen.
4/30	4:00 am **(pm)**	CL CC CD CF RI RL MD MF TD TW MR **(OT)**			Add 100 ml Replen - Reason unknown
5/4	5:30 am **(pm)**	CL CC CD CF RI RL **(MD)** **(MF)** TD TW MR OT			Tanks Low
5/5	8:30 **(am)** pm	CL CC CD CF RI RL MD MF TD TW MR **(OT)**			Replen. improp. mixed - dilute
5/7	3:05 am pm	CL CC CD CF RI RL MD MF TD TW MR **(OT)**			1st strip not from control box
5/15	9:15 **(am)** pm	CL CC CD CF RI RL MD MF TD TW **(MR)** OT			Microswitches stuck
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- MR - Mechanical Repair
- OT - Other (comment)

ANSWER: Replenisher microswitches stuck.

CORRECTIVE ACTION: Repair microwswitches and run several fully exposed films.

EXPLANATION: In this case, the cause of a processing problem could have been detected by observing the physical condition of the processor itself. An observant individual may have noticed that the developed replenisher tank was emptying unusually fast, and that the flow meters showed a continuous stream of replenishment.

The problem was traced to the replenisher microswitches which remained on permanently as a result of mechanical failure. Following mechanical repair, the processor was restarted and the problem solved. Remember, it is very important to remain alert to the physical condition of the processor. It is, after all, a machine, and machines can malfunction and break down.

Also, as with most machines, much may be observed about the processor's condition by listening to it. Many minor problems can produce noises different from usual. In this example, since you can hear the replenishment pumps on many processors, you may have noticed that the pumps were running continuously, or, at least, that they were not going on and off. Thus, listen!

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			oxidation - add 100ml Replen.
4/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100ml Replen - Reason unknown
5/4	5:30 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Tanks Low
5/5	8:30 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. improp. mixed - dilute
5/7	3:05 am pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			1st strip not from control box
5/15	9:15 (am) pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Microswitches stuck
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
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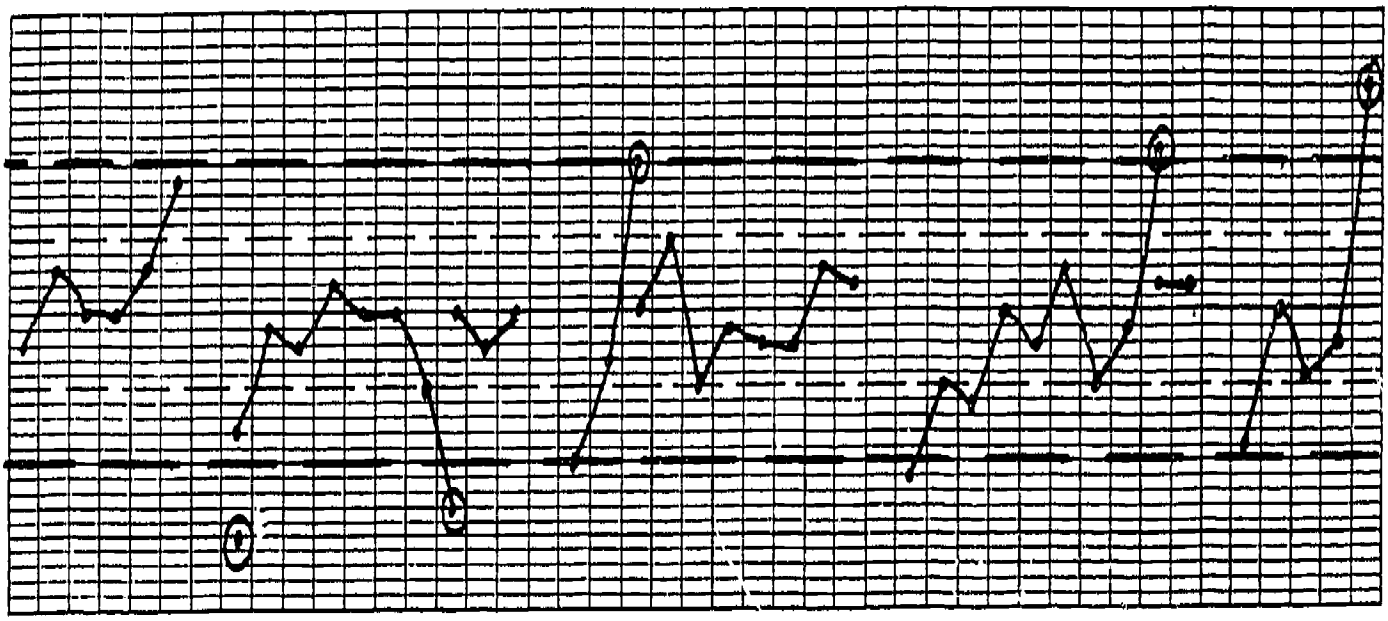
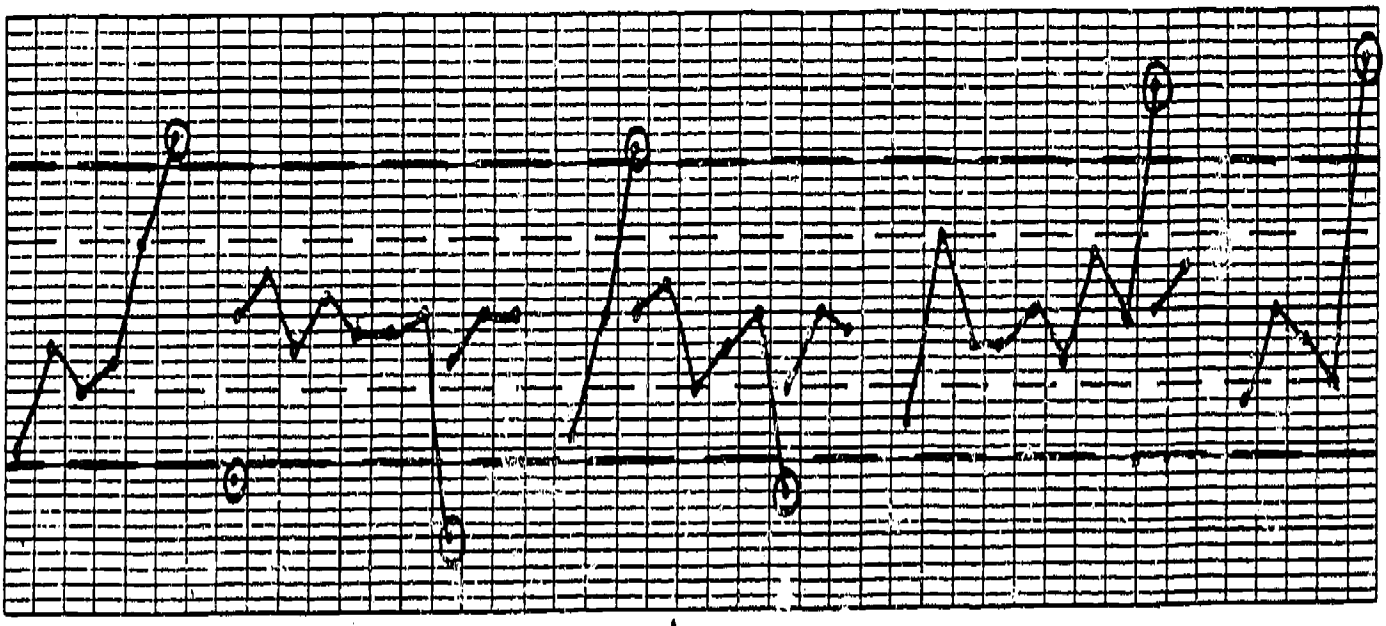
FACILITY GENERAL HOSPITAL PROCESSOR MAIN MONTH APR/MAY

DATE	22	22	23	23	24	24		27	27	28	28	29	29	30	30	1	1		4	4	5	5	6	6	7	7	8	8		11	11	12	12	13	13	14	14	15	15		18	18	19	19	20
TIME	9	3	9	3	9	3		8	4	9	4	9	3	9	4	10	4		8	4	8	3	9	3	9	3	9	3		9	4	9	4	9	4	10	4	9	4		9	3	9	3	9

DENSITY DIFFERENCE (CONTRAST) (STEP___ – STEP___)



MEDIUM DENSITY (STEP___)



BASE PLUS FOG

	20	19	19	20	20	20		19	20	20	19	19	20	20	19	20	20		19	20	20	20	20	19	20	19	20	20		19	19	20	20	20	20	19	20	20	20		19	20	19	20	20

D-MAX

ACTIONS ON PROCESSOR

Date	Time	Actions (Circle One - See Key)	Previous Setting	New Setting	Comment
4/24	4:10 am (pm)	CL CC CD CF RI (RL) MD MF TD TW MR OT	.80	.75	
4/27	8:05 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Oxidation - add 100ml replen.
4/30	4:00 am (pm)	CL CC CD CF RI RL MD MF TD TW MR (OT)			Add 100ml replen - reason unknown
5/4	5:30 am (pm)	CL CC CD CF RI RL (MD) (MF) TD TW MR OT			Tanks low
5/5	8:30 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			Replen. improp. mixed - dilute
5/7	3:05 am pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			1st strip not from control box
5/15	9:15 (am) pm	CL CC CD CF RI RL MD MF TD TW (MR) OT			Microswitches stuck
5/20	9:10 (am) pm	CL CC CD CF RI RL MD MF TD TW MR (OT)			strip film caused overreplen.
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			Ran 10 fully exp. films
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			
	am pm	CL CC CD CF RI RL MD MF TD TW MR OT			

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- OT - Other (comment)

ANSWER: Overreplenishment caused by single emulsion roll film tripping microswitches.

CORRECTIVE ACTION: Run several fully exposed films.

EXPLANATION: The problem indicated in this exercise is one which may be severe in facilities that routinely process strip film (105 mm, cine, etc.) through the regular department processor. If the roll film is processed in such a way as to trip the replenisher microswitches, then replenishment will be pumped into the processor during the entire length of the strip film, without using up nearly that amount of developer. Possible corrective actions:

1. If the processor has microswitches located only at either end of the feed tray, then process the strip film only down the center; then either manually add replenisher as needed (i.e., as indicated by a sensitometric strip) or use a previously processed film as a leader*.

2. If the processor has microswitches controlled by a single bar along the entire length of the feed tray, either replace or readjust the switches so that roll film does not trip them, or turn replenishment rate down very low prior to processing the strip film; afterwards return rate to normal and correct as before. If this procedure is not followed, improper replenishment may result after every strip film processed.

*Since the single emulsion roll film is generally of much lower average density (being single emulsion) than sheet film, the previously processed leader will usually provide sufficient replenishment, but not if large amounts of roll film are run at once. In this case, it would probably be worthwhile to invest in a roll film processor rather than continue to process roll film under possibly less than ideal conditions.

AFTERWORD

As a result of the previous exercises, a few patterns of emphasis may have become evident to the reader. These points are, in fact, very important and are summarized here one last time as a final word:

(1) Many processing problems are the result of human error in actions taken on the processor. These can often be avoided by following a few simple rules: whenever chemistry is changed or remixed, test it (either sensitometrically for chemistry inside the processor or by specific gravity for replenisher) do not make thermostat adjustments unless it is fairly certain that the thermostat is improperly set; finally, be sure to enter all actions taken on the processor in the maintenance log so problems related to those actions may be quickly corrected when they do occur.

(2) Two of the more common processing problems are caused by improper replenishment and improper wash water temperature. The first will usually have to be lived with as unavoidable if there is a large daily variation in workload and exam distribution. The second can usually be eliminated to some extent through investment in high quality mixing valves and pressure regulators.

(3) Remember not to spend a lot of time tracking down the source of every processing problem. If you cannot be find it in about a half hour or less, then proceed to counteract it without looking further. If a problem reappears, then spend more time in searching out its origin.

(4) With experience, most problems can be quickly and easily solved with little more than diligent monitoring and common sense.

A word of warning (and consolation) is given to "small" facilities with automatic processors which process 50 sheets of 14" x 17" film (or the equivalent) per day. These "low volume" processors are, for the most part, extremely difficult to stabilize or maintain. Success may be achieved, however, through the use of standby systems and a technique known as "flood replenishment," a method in which developer replenisher containing starter solution is introduced into the processor at timed intervals, regardless of the number of films being processed (3).

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