



## **NATIONWIDE EVALUATION OF X-RAY TRENDS (NEXT)**

### **PROTOCOL FOR 2003 SURVEY OF FLUOROSCOPIC X-RAY SYSTEMS**

**September 2009**

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**Nationwide Evaluation of X-ray Trends (NEXT)  
Protocol for  
2003 Survey of Fluoroscopic X-Ray Systems**

Prepared by

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Food and Drug Administration (FDA)  
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in association with

Conference of Radiation Control Program Directors, Inc.'s  
**Committee on Nationwide Evaluation of X-ray Trends (H-4)**

and

American College of Radiology

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## FOREWORD

The Conference of Radiation Control Program Directors, Inc. (CRCPD) is an organization made up of the radiation control programs in each of the 50 States, the District of Columbia, and Puerto Rico, and of individuals, regardless of employer affiliation, with an interest in radiation protection. The primary purpose and goal of CRCPD is to assist its members in their efforts to protect the public, radiation workers, and patients from unnecessary radiation exposure. CRCPD also provides a forum for centralized communication on radiation protection matters between the States and the Federal government, and between the individual States.

One method of providing assistance to the States, as well as to other interested parties, is through technical and administrative publications. Most technical publications of CRCPD are written by various committees, task forces or special working groups. Most administrative publications are written by staff of the Office of Executive Director (OED).

CRCPD's mission is "to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education."

This particular publication, *Nationwide Evaluation of X-ray Trends (NEXT) Protocol for 2003 Survey of Fluoroscopic X-Ray Systems*, contains the survey procedures developed to collect information for a population-representative reference database documenting diagnostic imaging with x-ray fluoroscopy.



Adela Salame-Alfie, Chairperson  
Conference of Radiation Control  
Program Directors, Inc.

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## PREFACE

This document contains the survey procedures developed to collect certain information for a population-representative reference database documenting diagnostic imaging with x-ray fluoroscopy. The 2003 NEXT fluoroscopy survey consisted of a site visit by trained state radiation personnel, and a facility questionnaire.

The protocol asked for information about the particular units being surveyed and the technique factors that the facility normally used for fluoroscopic procedures. The surveyor was to measure x-ray exposure and obtain some data relating to image quality and film processing.

Surveyors were requested to elicit responses to the [Facility Questionnaire](#) from facility staff that were familiar with the site's practice of diagnostic imaging with fluoroscopy.

The following states participated in this survey:

Arkansas	Maine	Pennsylvania
Arizona	Michigan	Rhode Island
California	Mississippi	South Carolina
Idaho	Nebraska	Texas
Illinois	New Jersey	Utah
Iowa	North Carolina	Virginia
Kentucky	North Dakota	Washington
Louisiana	Ohio	Wisconsin
Massachusetts	Oregon	

We recognize the voluntary nature of participating in this survey by the various state radiation control programs, and we appreciate these efforts. We also recognize the American College of Radiology for their generous financial support for surveyor travel to training.

*Richard Kaczmarek*

Richard Kaczmarek  
Food and Drug Administration  
Division of Mammography Quality and Radiation Programs

*Mary Ann Spohrer*

Mary Ann Spohrer, Chairperson  
Committee on Nationwide Evaluation  
of X-ray Trends

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## ABSTRACT

Kaczmarek, Richard, Spelic, David C., CRCPD Committee on Nationwide Evaluation of X-ray Trends, *Nationwide Evaluation of X-ray Trends (NEXT) Protocol for 2003 Survey of Fluoroscopic X-Ray Systems*, CRCPD Publication E-09-4 (September 2009) (39 pp.).

This survey protocol has been developed to obtain certain information concerning diagnostic imaging with x-ray fluoroscopy. It describes the information to be gathered and the methods for obtaining it. The facilities to be surveyed are chosen randomly from a nationwide list. Each state is given a list of facilities to survey using these procedures. The information requested is different in some respects from that which many States normally collect during their visits to x-ray facilities.

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## INTRODUCTION

This survey protocol has been developed to obtain certain information concerning diagnostic imaging with x-ray fluoroscopy. It describes the information to be gathered and the methods for obtaining it. The facilities to be surveyed are chosen randomly from a nationwide list. Each State is given a list of facilities to survey using these procedures. The information requested is different in some respects from that which many States normally collect during their visits to x-ray facilities.

Through the selection of a national sample and the use of a complete protocol by all participants for this small number of surveys, the total amount of the data collected can be reduced. For success and completeness of the project, every facility in the sample should be surveyed. All data elements should be acquired by following the guidelines indicated.

The protocol asks for information about the particular units being surveyed and the technique factors that the facility normally uses for fluoroscopic procedures. The surveyor will measure x-ray exposure and obtain some data relating to image quality and film processing. In each facility, the unit to be surveyed should be the one that is most frequently used to perform the procedure. You should select the room where the facility conducts the majority of their upper G.I. studies.

It is preferred that the survey form be completed electronically. However, if it is done on paper we recommend using pencil so that errors are more easily corrected. Crossing out errors and writing outside boxes is more likely to result in mistakes when entering data from paper forms. Groups of boxes for a single entry **SHOULD** be filled with leading or trailing zeros as appropriate unless indicated otherwise in this protocol. For example, if an exposure measurement of 78.0 mR is obtained, it should be coded 0078.0.

### **About this survey protocol**

This survey has been modified somewhat from that used for the 1996 survey. A separate questionnaire is now provided for the facilities that perform G.I. fluoroscopy. This form requests information regarding their quality assurance and quality control programs as well as further details regarding their equipment and procedures. We ask that you mail or fax this separate form to the facility prior to your arrival. Advance transmission will give the facility personnel time to complete the form and also allows you to review and clarify their responses prior to leaving the facility after your survey.

### **Your state facility sample**

The number of facilities you are asked to survey is based on your state's population relative to the rest of the U.S. You will receive a list of facilities you will be asked to survey, and you will also be provided with alternate facilities in the event the primary facility does not wish or is not able to participate. Please do not select the alternates over the primary facility merely because it

is convenient or near a desirable location because biased selections may compromise the integrity of the random sample. However, we do understand that the finite resources and time of your state program may preclude you from traveling to some facilities. If you have any questions regarding your facility sample, contact Rick Kaczmarek or David Spelic.

### **What you should do before starting your surveys**

- Review your facility sample: you may be aware of facilities that are no longer in operation, or there may be locations you cannot visit. Please advise us as soon as possible regarding these matters.
- Check the calibration of your MDH survey meter and probe. They should be calibrated **BY CDRH** annually. If you need to make arrangements for calibration, contact Rick Kaczmarek or David Spelic.

**NOTE: It is acceptable to use an MQSA-calibrated sensitometer and/or densitometer.**

- Check the calibration of your sensitometer and densitometer. These instruments also should be calibrated **by CDRH** annually. Contact Stephanie Belella or Dave Spelic if they are near the end of their current calibration period.
- The fluoroscopy phantom requires minimal assembly.

### **What to bring with you to the survey site**

You will need the following equipment and supplies for each survey:

1. CDRH upper gastrointestinal fluoroscopy phantom
2. CDRH image-quality test-tool
3. Calibrated MDH model 1015 or 1515 survey meter with calibrated 10X5-6 probe
4. Aluminum filters for HVL determination (2.0 mm and 1.0 mm increments)
5. Calibrated sensitometer and densitometer
6. One box of STEP test control film and appropriate STEP worksheet
7. Fog folder or other similar darkroom fog test tool
8. Protocol and survey form (along with facility questionnaire, if appropriate)
9. NEXT tri-folds for the facility

Your NEXT fluoroscopy phantom set should include the following items:

1. One fluoroscopy phantom body

2. One brass mounting plate for attaching the MDH probe
3. One plastic bolt for attaching the mounting plate to the phantom body
4. One plastic side plate for supporting the remaining end of the phantom
5. One fluoroscopy image quality test tool (referred to as the 'hockey puck')
6. One copper plate (supplied with the phantom)
7. One lead sheet (supplied with the phantom)
8. Gray shipping case with wheels

**What items you are asked to return to CDRH**

In addition to the paper survey form, you will be provided an electronic spreadsheet with which to record your data. You will be provided one spreadsheet file for each facility you are asked to survey. The paper forms are actually printed copies of the Excel spreadsheet files; hence you may print paper copies from the provided disk(s).

Please return your survey materials to the following address:

*At the time of the survey:*

Attention: Rick Kaczmarek  
 David Spelic  
 1350 Piccard Drive  
 HFZ-240  
 Rockville, MD 20850

*In 2009 CDRH moved to:*

10903 New Hampshire Avenue  
 W066 – Mail Drop 4521  
 Silver Spring, MD 20903-0002

The telephone number is 301/796-5710

**Contact Information:**

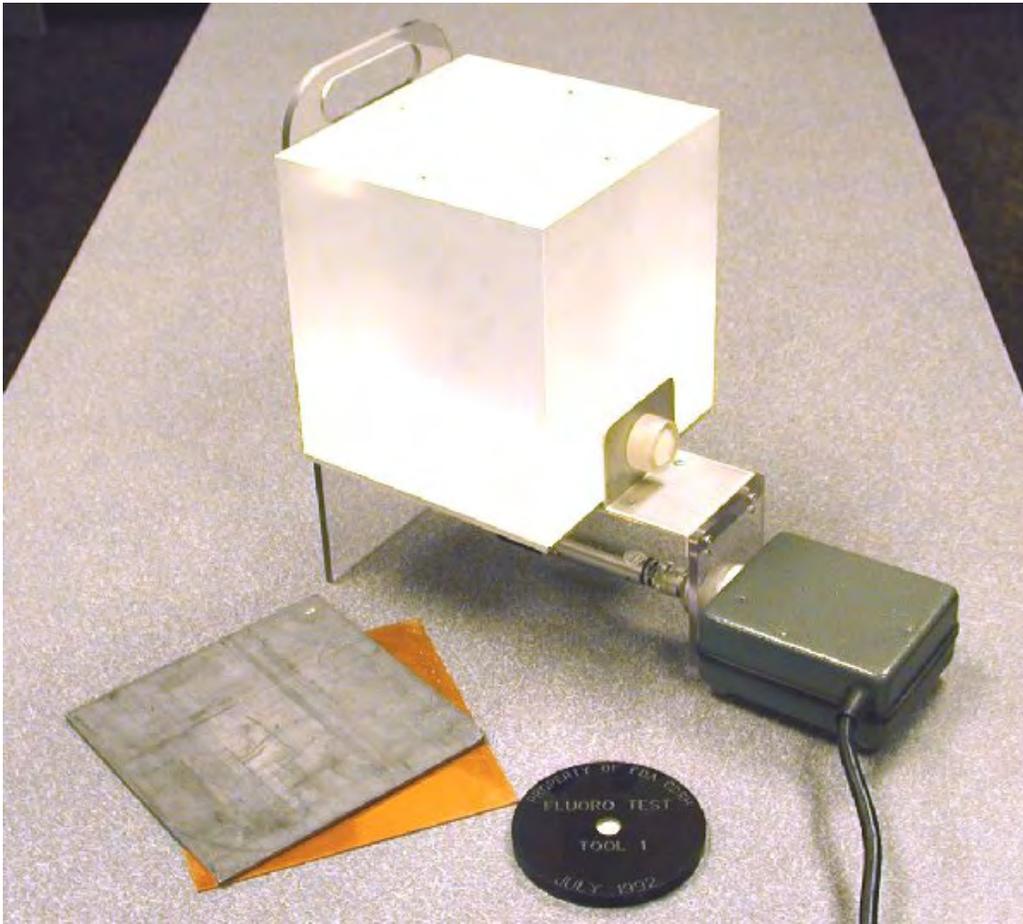
*At the time of the survey:*

Richard Kaczmarek  
 301-827-1230  
[rvk@cdrh.fda.gov](mailto:rvk@cdrh.fda.gov)

David C. Spelic  
 301-594-0865  
[dcs@cdrh.fda.gov](mailto:dcs@cdrh.fda.gov)

*In 2009, when this document was published:*

Kaczmarek, Richard V. [Richard.Kaczmarek@fda.hhs.gov]  
 Spelic, David C. [David.Spelic@fda.hhs.gov]



The NEXT Fluoroscopy Phantom

For each survey, you are asked to return the following to CDRH:

- Completed paper survey form (*MAKE A PHOTOCOPY OF YOUR ORIGINAL*) or spreadsheet disk if used
- Facility questionnaire
- Phantom film(s)
- Fog film(s)
- STEP film and worksheet
- HVL graph

*We appreciate your participation!*

**A. GENERAL SURVEY INFORMATION - FACILITY IDENTIFICATION**

- 1. **Facility Name:** Enter the name of the hospital or x-ray facility in the space provided. If the x-ray system is located in a private office, use the name of the physician.
- 2. **Person Interviewed:** Write the initials, last name and title or position of the person who provided the information regarding the system.
- 3. **State Code:** Use the appropriate two letter abbreviation (postal codes) in the space provided.

STATE CODE

EXAMPLE: | V | A |

- 4. **Facility Identification Number:** Enter the facility identification number. This is an identification number assigned by your State program. Space is provided for ten (10) characters. If your identification number has less than ten (10) characters, enter it with **LEADING ZEROS** as appropriate. The number may **NOT** be totally **BLANK**. Letters or numbers may be used in any combination. Hyphens (-) are acceptable but **NO OTHER SYMBOLS ARE ALLOWED**.

FACILITY IDENTIFICATION NUMBER

EXAMPLE: | 2 | 3 | 4 | 5 | 6 | B | 7 | C | 3 | 2 |

**or if less than 10 digits:** | 0 | 0 | 0 | 0 | 0 | 7 | F | L | 8 | 4 |

- 5. **Date of Survey:** Enter the date on which the survey was done. Note the boxes are for month, day, and year, in that order. Always use two digit numbers. For example July 26, 2003 would be coded:

DATE OF SURVEY

EXAMPLE: | 0 | 7 | 2 | 6 | 0 | 3 |

MO DA YR

- 6. **Room Number:** Enter the room or tube number here. This five digit number is to be assigned by the surveyor in a manner such that no two units within a given facility have the same number. Letters and numbers may be used in any combination. Hyphens (-) are acceptable but no other symbols are allowed; leading blanks are acceptable. It may be helpful to further identify the unit in the comments section by giving information pertaining to the make and type of x-ray machine so that if the facility is re-surveyed, the same number can be assigned to

the same unit. One method might be to use the last five digits of the tube's serial number for ease of identification.

ROOM NUMBER

EXAMPLE:    | 2 | B | - | 8 | 5 |

7.    **Type of Facility:** Determine the **Type of Facility** from the list below and enter the corresponding code in boxes. If code 99 (meaning "other") is used, please specify the type of facility under Surveyor's Comments.

TYPE OF FACILITY

EXAMPLE:    | 0 | 1 |

The following codes and definitions apply to **Type of Facility** for the NEXT surveys. In selecting codes for facilities where more than one code would apply, use the first applicable code listed. For example, a medical school hospital could be coded "02 hospital" or "05 school" under Type of Facility. The proper code will be "02 hospital" since it appears first on the list.

TYPE OF FACILITY CODES

- 01 = Private Practice:** An individual practitioner or a group of practitioners engaged in the same specialty. This includes a group of general practitioners. **If 01 is used, then Type of Practice must also be coded.**
- 02 = Hospital:** A facility that has beds for overnight care of patients.
- 03 = Multiple Specialty Practice:** A group of practitioners having different specialties. This includes school infirmaries, clinics, HMO's, DMS's, etc.
- 04 = Mobile Unit:** An x-ray machine transported by motor vehicle.
- 05 = School:** An educational institution. School infirmaries or clinics are coded 03. Medical school hospitals are coded 02.
- 06 = Private Laboratory:** A commercial facility that takes diagnostic radiographs by prescription but is not involved in film interpretation.
- 07 = Health Agency:** Voluntary and governmental health agencies that do not fall under any of the above categories.
- 08 = Industry:** A plant dispensary or first aid station.
- 09 = Nursing Home:** A facility with provisions for long-term care of patients.
- 10 = Breast Clinic:** A facility specializing in mammography and breast disease.
- 11 = Hospital Satellite Facility:** A facility affiliated with a hospital or medical center that is physically removed from the hospital/ medical facility (i.e., different mailing address)

**99 = Other:** Please specify in comments section.

- 8. Facility Specialty Code:** Use this code listing if the facility specializes in a certain type of medical practice (e.g., pediatrics). If the Type of Facility (see above) is coded "**01**" **Private Practice**, then determine the appropriate facility specialty code from the list below. If the facility is not coded "01" Private Practice, leave the Facility Specialty Code boxes blank.

**LIST OF FACILITY SPECIALTY CODES**

01 = DENTAL (EXCEPT ORTHODONTICS)	17 = ENDOCRINOLOGY
02 = ORTHODONTICS	18 = GERIATRICS
03 = MEDICAL G.P.	19 = HEMATOLOGY
04 = RADIOLOGY	20 = IMMUNOLOGY
05 = INTERNAL MEDICINE	21 = INFECTIOUS DISEASES
06 = SURGERY	22 = NEPHROLOGY
07 = UROLOGY	23 = NEUROLOGY
08 = PEDIATRICS	24 = NUCLEAR MEDICINE
09 = ORTHOPEDICS	25 = ONCOLOGY
10 = GASTROENTEROLOGY	26 = OPHTHALMOLOGY
11 = CHIROPRACTIC	27 = OTOLARYNGOLOGY
12 = PODIATRY	28 = PHYSICAL MEDICINE
13 = OSTEOPATHY	29 = PULMONARY MEDICINE
14 = OB/GYN	30 = EMERGENCY MEDICINE
15 = CARDIOLOGY	99 = OTHER
16 = ELECTROPHYSIOLOGY	

FACILITY SPECIALTY CODES

EXAMPLE: | 0 | 3 |

- 9. Survey Unit Workload:** Enter the number of adult upper gastro-intestinal fluoroscopy examinations normally performed per week **with this fluoro unit**. The actual workload or an estimate should be entered, with a minimum of one procedure per week. Take some time to assure this value is as reliable as possible. The workload refers only to the examination that is being surveyed, and should not include any other examinations. Please indicate in the comments section of the survey form if the unit surveyed is not the one on which the majority of upper G.I. fluoro studies done at the facility are performed (or if the facility regularly performs these exams on two or more units).

FLUORO UNIT WEEKLY  
UPPER G/I. WORKLOAD (exams/week)

EXAMPLE: | 0 | 0 | 5 |

- 10. Facility Weekly Workload:** Enter the number of adult upper gastro-intestinal fluoroscopy examinations normally performed per week **at the entire facility**. As in the previous question, no other procedures should be included, and either the actual workload or an estimate should be entered. As an example, a facility may have two fluoroscopy rooms where upper G.I. exams are done, with the workload about evenly split. In this case the answer given here would be twice what is recorded in question nine.

FACILITY WEEKLY  
UPPER G/I. WORKLOAD

EXAMPLE:            | 0 | 1 | 0 |

**B. EQUIPMENT DATA**

- 1. X-Ray Unit Control Manufacturer:** Determine the manufacturer of the x-ray unit and write the name in the space provided. Determine the code for the manufacturer from the list in Supplement Section B and enter the appropriate code in the boxes.

X-RAY CONTROL  
MANUFACTURER

EXAMPLE:            | G | E | C | O |

- 2. X-Ray Unit Control Year of Manufacture:** Determine the Year of manufacturer of the x-ray control unit and enter the last two digits of the year in the boxes provided e.g. 1995 would be entered as 95.

YEAR OF MANUFACTURE

EXAMPLE:            | 8 | 5 |

- 3. Type of Equipment:** Determine the type of equipment from the code list and enter the corresponding code.

TYPE OF EQUIPMENT CODES

- 1** = Under-table fluoroscopic **NON IMAGE INTENSIFIED**
- 2** = Under-table fluoroscopic **IMAGE INTENSIFIED WITHOUT TV Monitor**
- 3** = Under-table fluoroscopic **IMAGE INTENSIFIED WITH TV Monitor**
- 4** = Over-table fluoroscopic **IMAGE INTENSIFIED** (includes special procedures, cardiac catheterization, bi-plane, etc.)
- 5** = Mobile C-Arm

TYPE OF EQUIPMENT

EXAMPLE:            | 1 |

4. **Contrast:** Determine the type of contrast, single (e.g., barium) or double (e.g., barium and effervescence [air]), and which technique, single or double contrast, is most frequently used for the examination being surveyed. Select the code from the following list and enter the appropriate code in the box.

CONTRAST CODES

- A = Only** - single (contrast)  
**B = Only** - double (contrast & effervescence [air])  
**C = Both** - radiopaque contrast most frequently used  
**D = Both** - effervescence (air) most frequently used  
**E = Both** - approximately **Equal use**  
**F = None**

CONTRAST

EXAMPLE:            | A |

5. **Image Intensifier (I.I.) Field Size:** There are several image intensifier (I.I.) field sizes for doing fluoroscopic examinations, i.e., field sizes such as 4", 6", 9" 12", etc. Determine which I.I. **field size is normally used for the examination being surveyed** and enter the value in the box. Indicate the units i.e., "IN" = inches or "CM" = centimeters.

I.I. FIELD  
SIZE                    UNITS

EXAMPLE:            | 0 | 9 |                    | I | N |

6. **Grid Used for Fluoroscopy:** Determine if a grid is used routinely for the *fluoroscopic* examination. This may be a separate fluoroscopy grid mounted on the II, or the spot film grid may be used. Indicate which type of grid, if any, is used by placing an 'X' in the appropriate box as shown below.

FLUOROSCOPY GRID

<u>EXAMPLE:</u>	<u>SPOT FILM</u>	<u>II GRID</u>	<u>NO GRID</u>
	<u> </u>	<u>  X  </u>	<u> </u>

### C. FLUOROSCOPY TECHNIQUE DATA

- 1. High-Level Control (also called Boost Mode):** Some fluoroscopic units are equipped with a high-level control option. This control requires positive action by the user to activate and permits the unit to exceed the 10 R/min limitation. Determine from the operator if this unit has the High-Level Control option and indicate "YES" or "NO" by marking the appropriate box. **HINT:** If the unit does not have a high-level mode, draw a line through those sections of the data form that are for high level. This will avoid confusion during the data collection.

#### HIGH LEVEL CONTROL

EXAMPLE:    YES        NO  
                         

- 2. Dose Setting:** Many fluoroscopic systems permit the user to select a dose setting. Indicate the dose setting routinely used for the fluoroscopic examination of a standard patient (the standard "NEXT" patient is a 5'8", 164 pound adult with a 23 cm chest and abdomen). Place an "X" in the appropriate box.

	<u>LOW</u>	<u>MEDIUM</u>	<u>HIGH</u>
	<u>DOSE</u>	<u>DOSE</u>	<u>DOSE</u>
<u>EXAMPLE:</u>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

- 3. Recording Modes:** Most fluoroscopy systems enable the user to record images on film or other modalities. Indicate the type of recording mode **most frequently** used on this unit by selecting a code letter from the following list and entering it in the appropriate box.

#### CODES FOR RECORDING MODE

**S**= Spot films that are obtained using a screen/film cassette technique  
**P**= Photo-spot refers to the use of roll or cut film, e.g., 70, 100,105 mm  
**V**= VideoTape Recorder  
**D**= Digital image recording  
**9** = Some other method is used. Explain in the comments section (e.g., cine)

#### RECORDING MODE

EXAMPLE:            |S|

**D. SPOT FILM DATA**

THIS INFORMATION NEED NOT BE CAPTURED IF SPOT FILM RADIOGRAPHY IS NOT INDICATED AS THE MOST FREQUENT METHOD OF IMAGE RECORDING (SEE QUESTION 3 OF PREVIOUS SECTION).

1. **Spot Film: Film Brand and Film Type, Screen Brand and Screen Type:** If spot films are routinely taken as a part of the upper GI examination, determine from the operator the screen-film combination used for the spot film. Record this combination on the lines provided, and from the Supplement Sections C and D, determine the film and screen codes, respectively, and enter in the appropriate boxes. **If the SCREEN and FILM codes are NOT on the list, write the COMPLETE NAMES, and the NAME, ADDRESS AND TELEPHONE NUMBER of the supplier in the comments section.**

	FILM <u>BRAND</u>	FILM <u>TYPE</u>
<u>EXAMPLE:</u>	<u> E K C 0 </u> (KODAK)	<u> R 0 C </u> (ORTHO-C)

	SCREEN <u>BRAND</u>	SCREEN <u>TYPE</u>
<u>EXAMPLE:</u>	<u> E K C 0 </u> (KODAK)	<u> L N M </u> (LANEX MED)

2. **Standard Spot Film Procedure:** Indicate the number of each type of spot **film** routinely taken for the upper GI examination. If some other type of spot film is routinely taken, indicate the number and specify the type in the comments section. **This is the number of FILMS, not the number of exposures.**

	<u>1 on 1</u>	<u>2 on 1</u>	<u>4 on 1</u>	<u>OTHER</u>
<u>EXAMPLE:</u>	<u> 0 4 </u>	<u> 0 3 </u>	<u> 0 3 </u>	<u>     </u>

3. **Spot Film Grid:** Determine whether a grid is normally used for spot film recording during the upper GI examination, code "G" if grid is used, or "N" for no grid. If unknown, then code the box "X." **THIS IS SPOT FILM GRID USE ONLY- NOT FLUOROSCOPIC.**

	SPOT FILM <u>GRID</u>
<u>EXAMPLE:</u>	<u> G </u>

4. **Spot Film Grid Ratio:** If a grid is normally used for spot film, determine from the operator the grid ratio. The grid ratio should be marked on the grid. If the

unit does not use a grid or the grid ratio is not obtainable, enter XX (do not leave blank).

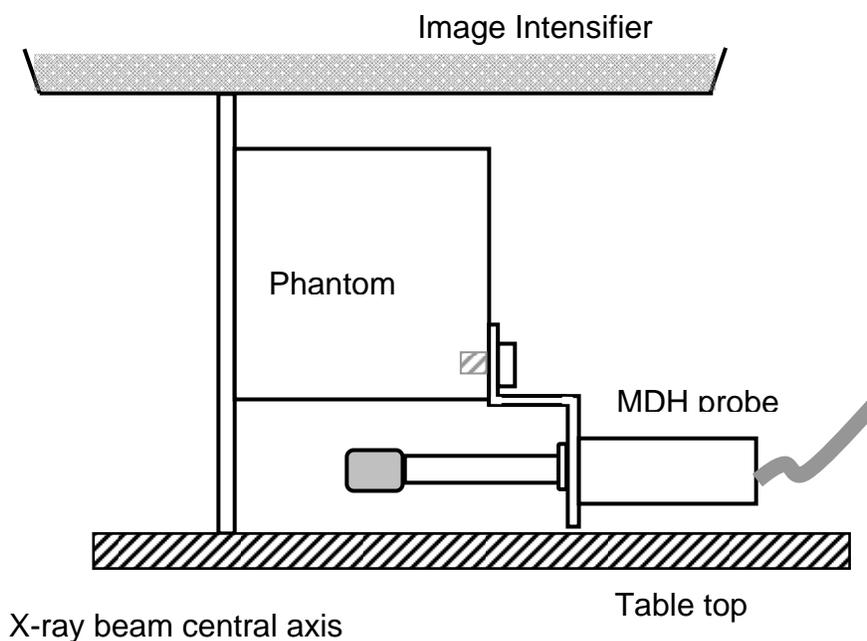
SPOT FILM  
GRID RATIO

EXAMPLE: 1|2 : 1

**E. INSTRUCTIONS FOR GENERAL RADIOGRAPHIC/ FLUOROSCOPIC SURVEY PROCEDURE**

**1. Measurement Set-Up Procedure for Abdominal (Upper G.I) Study - R/F (Under-Table Unit)**

- a) Attach the side and MDH probe support to the fluoroscopic phantom as shown in figure 1 below. Place the MDH probe, with the rubber feet resting on the table, in the slot provided in the probe support. The phantom assembly will be upright on the table, with the probe centered under the phantom body.
- b) Have the technologist set up for a routine adult upper G.I. exam, including technique factors, grid position, image intensifier field size, dose mode, etc. Bring the I.I. down until it rests on the top of the phantom side extension. Align the phantom and probe in the center of the field by making fluoroscopic exposures and observing the image of the phantom.
- c) Adjust the collimator until the beam is limited in size to the area indicated by the four (4) lead shot markings on the phantom top. Note: If the selected field size is greater than 9" (23cm), you will have to close the shutters. If you cannot see the four (4) lead shot, the selected I.I. field is less than 9". Lock the I.I. in this position. Once you have set up the phantom, MDH probe and unit, do not move them until you have completed the exposure and exposure rate measurements.

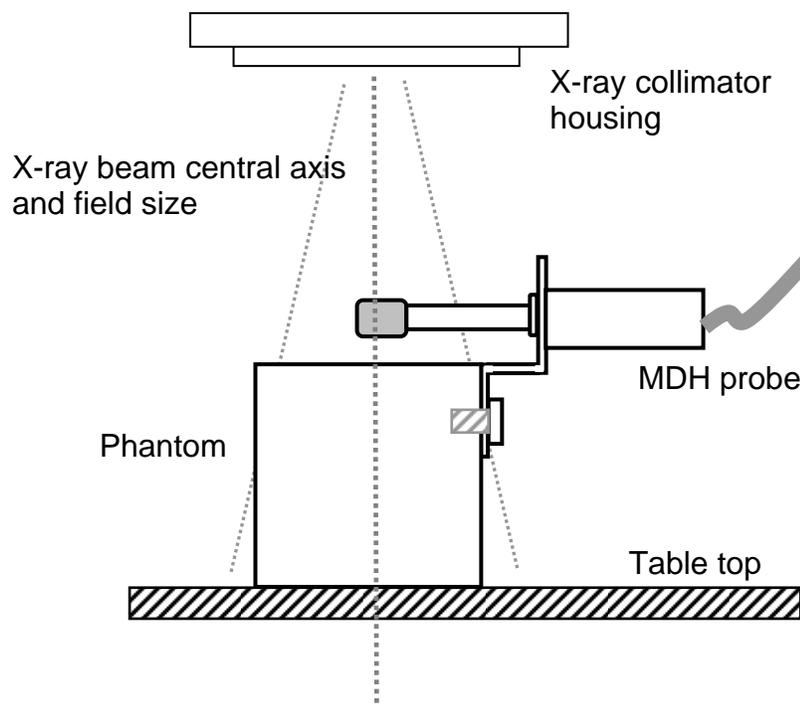


**Figure 1.** Set-up configuration for under-table units.

## 2. Measurement Set-Up for Over-Table Units

- a) Attach the MDH probe support to the fluoroscopic phantom- **do not attach the Lexan side**. Place the phantom on the table top with the probe support nearest the tube head as shown (figure 2). Place the MDH probe in the slot provided in the probe support. The probe will be centered over the phantom body.
- b) Select the 9" field size of the image intensifier (I.I.). Have the technologist set up the other parameters pertaining to an adult upper G.I. exam (e.g., x-ray technique). Align the phantom and probe in the center of the field. Note: If you cannot see the four (4) lead shot, the I.I. field is less than 9". (If the 9" field size is not available, select the field size closest to 9" and indicate in the comments section the I.I. field size selected.)

- c) Have the operator position the tube assembly at the normal height for the upper GI examination. Lock the assembly at this height. Once you have set up the phantom, MDH probe and unit, do not move them until you have completed the exposure and exposure rate measurements.
- d) By making fluoroscopic exposures and observing the image of the phantom, adjust the collimator until the beam is limited in size to the area indicated by the four (4) lead shot markings on the phantom (area indicated by the four (4) lead shot located at the center on each edge of the phantom).



**Figure 2.** Set-up configuration for over-table units.

**3. Fluoroscopic Exposure Rate Data - Abdominal (Upper G.I.) Study For Over-Table AND Under-Table Set-Ups**

**Fluoroscopic kVp, mA, and MDH Exposure Rate:** Set the MDH selector switch to the "EXPOSURE RATE" mode. Without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned, and the beam collimated to the four markings on the phantom, make an exposure and hold until the meter reading stabilizes. **RECORD THIS EXPOSURE RATE in mR/min as Fluoroscopy Exposure Rate #1.** Record the

**fluoroscopic kVp** selected as Fluoroscopy kVp #1. If the unit has an mA indicator, read and record the mA value during the exposure as Fluoroscopy mA #1.

	Fluoroscopy EXPOSURE RATE #1 (mR/min)	Fluoro mA #1	Fluoro kVp #1
<u>EXAMPLE:</u>	<u>  0   0   8   0   0  </u>	<u>  0   0   .   2  </u>	<u>  0   9   0  </u>

If the exposure rate is greater than 1 R/min, the values are recorded as 1000 mR/min per R/min. For example, 12 R/min would be coded 12000 mR/min.

Repeat the exposure and record the values for Fluoro Exposure Rate #2, Fluoro mA #2, and Fluoro kVp #2, respectively.

**4. Fluoroscopic kVp, mA and MDH Exposure Rate with Copper Filter**  
*For Over-table AND Under-Table Set-Ups*

**DO NOT make this measurement for MANUAL systems.**

Set the MDH selector switch to the "**EXPOSURE RATE**" mode. Without making any changes in the standard patient techniques, ensure that the phantom and MDH probe are properly positioned, and the beam collimated to the four markings on the phantom. Place the 1 mm sheet of copper on the upper surface of the phantom- see Figures 3 (under-table units) and 4 (over-table units) below. **YOU SHOULD NOT NEED TO MOVE THE PHANTOM!** Begin exposure as above, and hold exposure until you see that the meter reading is steady.

**RECORD THIS EXPOSURE RATE AS FLUORO COPPER EXPOSURE RATE #1.** Record the selected kVp as Fluoro Copper kVp #1. If the unit has an mA indicator, read and record the mA value during the exposure as Fluoro Copper mA #1. Repeat the exposure a second time, and record the values for Fluoro Copper Exposure Rate #2, Fluoro Copper kVp #2, and Fluoro Copper mA #2, respectively.

	FLUORO COPPER EXPOSURE RATE #1 (mR/min)	FLUORO COPPER mA #1	FLUORO COPPER kVp #1
<u>EXAMPLE:</u>	<u>  0   1   2   0   0  </u>	<u>  0   3   .   0  </u>	<u>  0   9   0  </u>

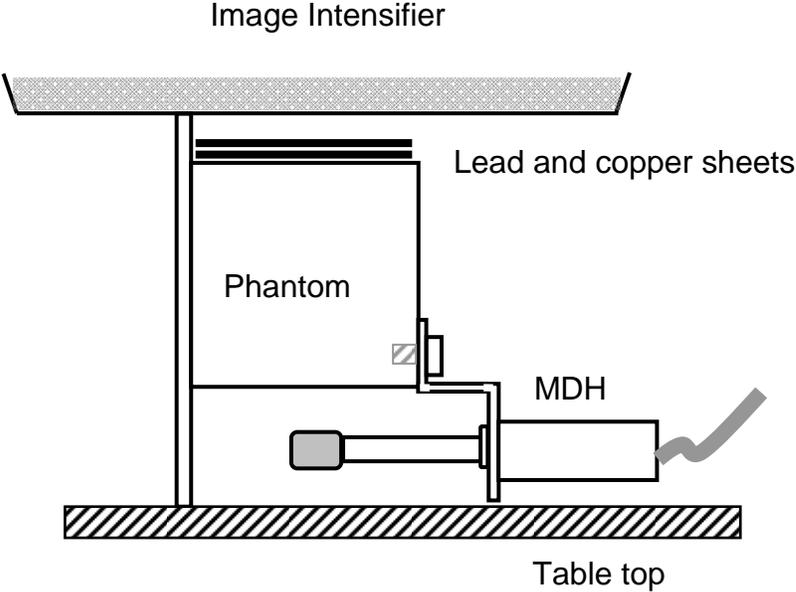
**5. Maximum Fluoroscopic kVp, mA and MDH Exposure Rate with Copper and Lead - For Over-Table AND Under-Table Set-Ups**

**DO NOT make this measurement for MANUAL systems.**

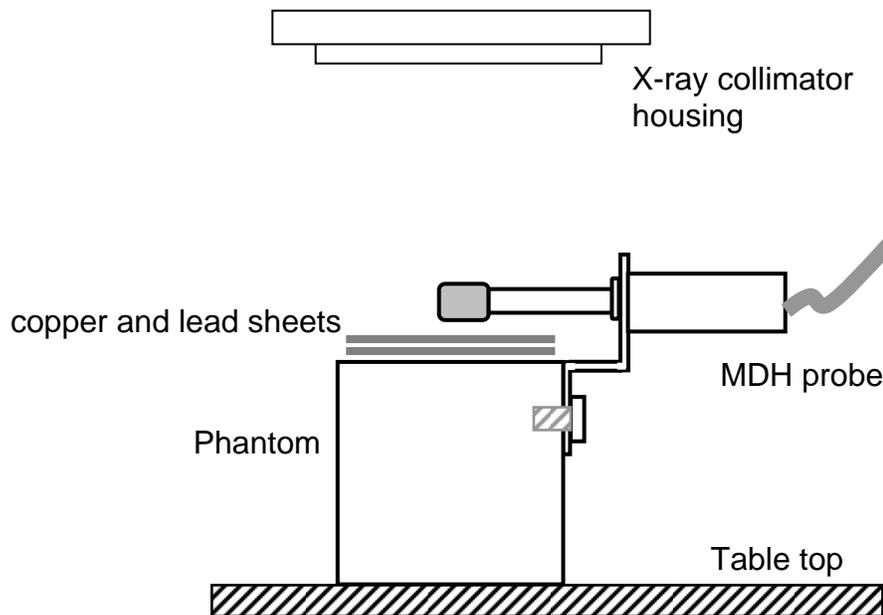
Set the MDH selector switch to the "EXPOSURE RATE" mode. Without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned and the beam collimated to the four markings on the phantom, place the 1 mm sheet of copper and the lead sheet on the upper surface of the phantom (see figure 3 OR figure 4). Initiate exposure and hold until the output (meter reading) stabilizes. **RECORD THIS EXPOSURE RATE as Fluoro Maximum-Exposure Rate #1.** Record the selected kVp as Fluoro Maximum-kVp #1. Read and record the mA value during the second exposure as Fluoro Maximum-mA #1. Repeat the exposure and record the values for Fluoro Maximum-Exposure Rate #2, Fluoro Maximum-kVp #2, and Fluoro Maximum-mA #2, respectively.

	FLUORO MAX EXPOSURE RATE #1 (mR/min)	FLUORO MAXIMUM mA #1	FLUORO MAXIMUM kVp #1
EXAMPLE:	1   3   2   0   0	0   5   .   0	1   1   0

**REMOVE THE COPPER & LEAD SHEETS FROM THE PHANTOM.**



**Figure 3.** Placement of copper and lead sheets for under-table units.



**Figure 4.** Placement of copper and lead sheets for over-table units.

**6. Fluoroscopic High-Level kVp, mA, and MDH Exposure Rate:  
For Over-Table AND Under-Table Set-Ups**

The following measurements are to be made **ONLY** on those systems that have an alternate dose rate option such as high-level mode.

**DO NOT make this measurement for MANUAL systems.**

Set the MDH selector switch to the "**EXPOSURE RATE**" mode. Without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned, and the beam collimated to the four markings on the phantom, place the system in the boost mode or high-dose mode of operation and make an exposure until the exposure rate stabilizes. **RECORD THIS EXPOSURE RATE AS FLUORO HIGH LEVEL EXPOSURE RATE #1.** Record the selected kVp as Fluoro High-Level kVp #1, and record the mA value during the exposure as Fluoro High-Level mA #1. Repeat the exposure and record the values for Fluoro High-Level Exposure Rate #2, Fluoro High-Level kVp #2, and Fluoro High-Level mA #2, respectively.

	FLUORO HIGH LEVEL EXPOSURE RATE #1 (mR/min)	FLUORO HIGH-LEVEL mA #1	FLUORO HIGH-LEVEL kVp #1
<u>EXAMPLE:</u>	<u>  0   2   2   0   0  </u>	<u>  0   3   .   0  </u>	<u>  0   9   0  </u>

**7. Fluoroscopic High-Level kVp, mA and MDH Exposure Rate with Copper Filter For Over-Table AND Under-Table**

The following measurements are to be made **ONLY** on those systems that have the high-level option. **DO NOT make this measurement for MANUAL systems.**

Set the MDH selector switch to the "**EXPOSURE RATE**" mode. Without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned and the beam collimated to the four markings on the phantom, place the 1 mm sheet of copper on top of the phantom (**see figure 3 (under-table units) OR figure 4 (over-table units)**), and select the high-level mode of operation. Begin exposure and hold until the meter reading is stable. **RECORD THIS EXPOSURE RATE AS FLUORO COPPER HIGH-LEVEL EXPOSURE RATE #1.** Record the selected kVp as Fluoro Copper High-Level kVp #1, and record the mA value during the exposure as Fluoro Copper High-Level mA #1. Repeat the exposure and record the values for Fluoro Copper High-Level Exposure Rate #2, Fluoro Copper High-Level kVp #2, and Fluoro Copper High-Level mA #2, respectively.

	FLUORO HIGH-LEVEL COPPER EXPOSURE RATE #1 (mR/min)	FLUORO HIGH-LEVEL COPPER mA #1	FLUORO HIGH-LEVEL COPPER kVp #1
<u>EXAMPLE:</u>	<u>  0   4   2   0   0  </u>	<u>  0   8   .   0  </u>	<u>  0   9   0  </u>

**8. Maximum High Level Fluoroscopic kVp, mA and MDH Exposure Rate with Copper and Lead for Over-Table AND Under-Table**

The following measurements are to be made **ONLY** on those systems that have the high-level option. **DO NOT make this measurement for MANUAL systems.**

Set the MDH selector switch to the "**EXPOSURE RATE**" mode. Without making any changes in the standard patient techniques, ensure that the phantom and MDH probe are properly positioned, that the beam is collimated to the four markings on the phantom, and that the 1 mm sheet of copper and the lead sheet are placed on top of the phantom (**see figure 3 (under-table units) OR figure 4**

(over-table units). Place the system in the high-level mode and make an exposure until the exposure rate (meter reading) is stabilized.

**RECORD THIS EXPOSURE RATE as High-Level Maximum-Exposure Rate #1.** Record the selected kVp as High-Level Maximum-kVp #1. Read and record the mA value during the exposure as High-Level Maximum-mA #1. Repeat the exposure and record the values for High-Level Maximum-Exposure Rate #2, High-Level Maximum-kVp #2, and High-Level Maximum-mA #2, respectively.

High-Level Max Exposure Rate #1 (mR/min)	High-Level Max Max mA #1	High-Level Max Max kVp #1
--	--------------------------------	---------------------------------

EXAMPLE:      | 2 | 5 | 0 | 0 | 0 |      | 3 | 5 | . | 0 |      | 1 | 1 | 0 |

**REMOVE THE COPPER AND LEAD SHEETS  
FROM THE TOP OF THE PHANTOM.**

## 9. Film Recording Data

If the facility uses film recording as a part of the upper GI examination, record the selected technique factors (kVp, mA, mAs, and time). Using the procedure below, measure and record the MDH exposure, MDH time.

**If the facility uses both spot and photo-spot, do your recording and measurements for the spot film system only.**

**CAUTION: RAISE THE I.I. HOUSING TO ALLOW ADEQUATE SPACE FOR THE COMPRESSION CONE TO COME INTO THE FIELD DURING FILM RECORDING PROCEDURES.**

**Select the Four-on-One (4-on-1) mode for ALL spot film recording measurements. If 4-on-1 mode is unavailable, select the mode closest to 4-on-1, such as 2-on-1 or 3-on-1.**

**SPOT or PHOTO-SPOT TECHNIQUE DATA - Selected kVp and mA:** Have the operator set up, at the console, the techniques routinely used for a spot or photo-spot film for the upper GI examination of a standard patient. Record the kVp and mA selected. Leave any missing values coded as blanks.

	SELECTED kVp	SELECTED mA
<u>EXAMPLE:</u>	<u> 1 1 0 </u>	<u> 0 1 5 0 </u>

**NOTE:** The **ONLY** technique factors, i.e., kVp and mA, recorded are those that are selected **PRIOR TO EXPOSURE**.

**Time and mAs (MANUAL MODE ONLY):** If AEC is NOT used routinely for spot films, then record the following **MANUAL MODE TECHNIQUE VALUES**. If time is preselected as part of the technique, then record it in the appropriate boxes. Time values are recorded in milliseconds. Some units have preselected mAs; for these units record the mAs value selected and leave the mA and time blank (see note). If the unit gives a post exposure digital readout of mAs, please indicate in the comments section if the mAs value recorded is post exposure.

MANUAL MODE ONLY

EXAMPLE:    |0|0|3|3|.3| and / or |0|0|6|7|

**NOTE: DO NOT** use survey meter reading for the preselected time or mAs. Only those values that are preselected or obtained from the x-ray unit's digital reading should be recorded.

**10. Spot or Photo-Spot Film - MDH Exposure and MDH Time**

**Check to be sure you have removed the copper and lead sheets from the phantom.**

**MDH Initialization Exposure** - Before the MDH can be used to measure exposure time, it must first be initialized. Set the MDH selector switch to the "**PULSE EXPOSURE**" mode. The pulse fraction threshold should be set at 0.2 for single-phase units and 0.5 for three-phase units (if the phase of the unit is not known, use 0.5). Set the x-ray unit for the **four-on-one (4-on-1) format**. Place a loaded spot film cassette in the unit and without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned (see above), and the beam collimated to the four markings on the phantom, make a single spot film or photo-spot exposure.

**RECORD THE EXPOSURE as Film Exposure #1. DO NOT RECORD THIS INITIALIZING TIME.**



	SELECTED FILM COPPER kVp	SELECTED FILM COPPER mA
<u>EXAMPLE:</u>	<u>  1   1   5  </u>	<u>  0   2   0   0  </u>

**NOTE:** The **ONLY** technique factors, i.e., kVp and mA, recorded are those that are selected **PRIOR TO EXPOSURE**.

**Time and mAs with Copper Filter - (Manual Mode ONLY):** If AEC is NOT used routinely for spot films, then record the **MANUAL MODE TECHNIQUE VALUES**. If time is preselected as part of the technique, then record it in the appropriate boxes. Time values are recorded in milliseconds. Some units have preselected mAs; for these units record the mAs value selected and leave the mA and time blank (see note). If the unit gives a post exposure digital readout of mAs, this value should be indicated in the comments section.

	<u>M A N U A L M O D E O N L Y</u>	
	<u>TIME</u> (msec)	<u>mAs</u>
<u>EXAMPLE:</u>	<u>  0   0   5   8   . 7  </u>	<b>and / or</b> <u>  0   1   3   7  </u>

**NOTE: DO NOT** use survey meter reading for the preselected time or mAs. Only those values that are preselected or obtained from the x-ray unit's digital reading should be recorded.

**SPOT or PHOTO-SPOT FILM - MDH EXPOSURE and MDH TIME with Copper Filter:**

Place the 1 mm sheet of copper on top of the phantom. Use a loaded cassette for the copper spot film measurements; this film may be discarded following exposure measurements.

**MDH Initialization Exposure with Copper Filter:** The MDH **must be re-initialized** before it can be used to measure exposure time for the copper. Set the MDH selector switch to the "**PULSE EXPOSURE**" mode. The pulse fraction threshold should be set at .2 for single-phase units and .5 for three-phase units (if the phase of the unit is not known, use .5). Set the x-ray unit for the **four-on-one (4-on-1) format**. Without making any changes in the standard patient techniques, with the phantom and MDH probe properly positioned, and the beam collimated to the four markings on the phantom, take a spot or photo-spot film.

**RECORD THE EXPOSURE as Film Copper Exposure #1. DO NOT RECORD THIS INITIALIZING TIME.**

Film with Copper Filter  
EXPOSURE # 1 (mR)

EXAMPLE:                    | 0 | 3 | 1 | 0 |

**DO NOT** manually reset the MDH to zero between exposures. Once you have initialized the MDH, you are ready to make subsequent exposures. Make an exposure, read and record the exposure measurement in mR as Film Copper Exposure #2. Switch the MDH to the "**PULSE DURATION**" mode, and record the "MDH Measured Time" as Copper Film #2-Time. Repeat this procedure twice more, reading and recording Film Copper exposure and time #3 and #4.

Film with Copper  
EXPOSURE #2 (mR)

Film with Copper  
Time # 1 (msec)

EXAMPLE:                    | 0 | 3 | 1 | 1 | mR

| 0 | 1 | 3 | 3 | . | 0 |

## **REMOVE THE COPPER FROM THE TOP OF THE PHANTOM**

### **F. RADIOGRAPHIC/ FLUOROSCOPIC HVL & IMAGE EVALUATION**

#### **1. General Guidelines for Half-Value Layer Determination**

**The type of unit will determine the procedure you use to determine the HVL. The manual mode method is preferred.**

For manual systems and/or ABC systems that can be placed into the manual mode, follow the procedure outlined in Section 2.

For the ABC units that cannot be placed in the manual mode, use the procedure in Section 3.

For over-table units, see Section 4.

For the HVL measurements on all units, **USE** the same kVp used for the fluoroscopic abdominal (e.g., **upper G.I.**) examination.

**HVL Method:** Indicate in the box provided, the method you used to determine the HVL. If the manual technique was used, code the box "M" and for the fixed aluminum method, code it "A". If you used another method, code the box "O" and provide us with an outline explaining your method.

HVL METHOD

EXAMPLE:        | M |

**Estimated HVL:** Using the graph on the back of the work sheet, plot the exposure rate versus the aluminum thicknesses used. Determine the HVL to the nearest tenth of a millimeter of aluminum by drawing the best straight line fit to all but the first (0 mm Al) data points.

ESTIMATED HVL

EXAMPLE:        | 0 | 4 | . | 5 |

**2. Manual Mode HVL for Under-Table Tube (PREFERRED METHOD)**

**The unit must be in the manual mode with automatic brightness control (ABC) disabled, for this method.**

- a) With the phantom and the MDH probe properly positioned (see figure 1), adjust the size of the fluoroscopic beam until it is slightly larger than the sensitive volume of the MDH probe head.
- b) Set the MDH selector switch to the "**EXPOSURE RATE**" mode.
- c) Without making any changes in the standard patient techniques, make an exposure until the MDH reading stabilizes. Adjust the mA to obtain an exposure rate of at least 1000 mR/min (1 R/min).
- d) **Record the kVp in the HVL section of the data form. RECORD THE EXPOSURE RATE** in mR/min as Exposure Rate for 0 mm of aluminum, e.g., 1.20 R/min is coded as 01200.0 mR/min and 12 R/min is coded as 12000.0 mR/min.

	<u>HVL kVp</u>	<u>mR/min with 0 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   9   0  </u>	<u>  0   1   2   0   0   .   0  </u>

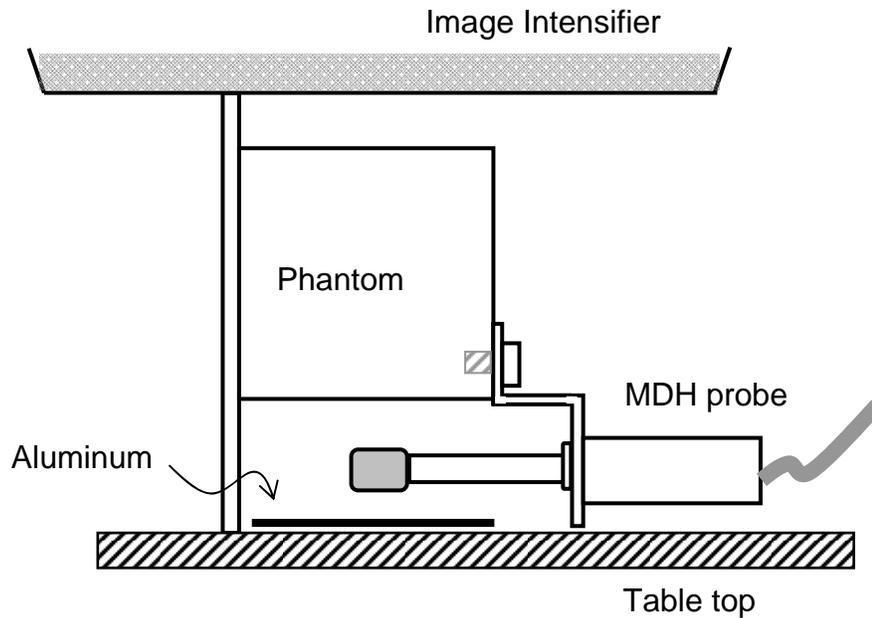
- e) Place 1.5 mm aluminum on the table top directly beneath the sensitive volume of the MDH probe and make a second exposure until the MDH reading stabilizes (figure 5). Record the output in mR/min in the spaces provided for 1.5 mm of aluminum.

	<u>mR/min with 1.5 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   0   9   2   5   .   0  </u>

- f) Place an additional 1 mm of aluminum on the table top directly beneath the sensitive volume of the MDH probe. Make an exposure until the MDH reading stabilizes and record in mR/min the reading for 2.5 mm of aluminum.

mR/min with 2.5 mm Al

EXAMPLE:      | 0 | 0 | 7 | 9 | 2 | . | 0 |



**Figure 5.** Placement of aluminum for HVL determination on under-table units.

- g) Place an additional 1 mm of aluminum on the table top directly beneath the sensitive volume of the MDH probe. Take an exposure until the MDH reading stabilizes and record in mR/min the reading for 3.5 mm of aluminum.

mR/min with 3.5 mm Al

EXAMPLE:      | 0 | 0 | 6 | 1 | 2 | . | 0 |

- h) If the value obtained with 3.5 mm Al is not less than 1/2 the 0 mm Al value, add as much Al filtration as necessary to reduce the exposure rate to less than 1/2 the 0 mm Al value. Record the resulting exposure rate value and the total thickness of aluminum used.

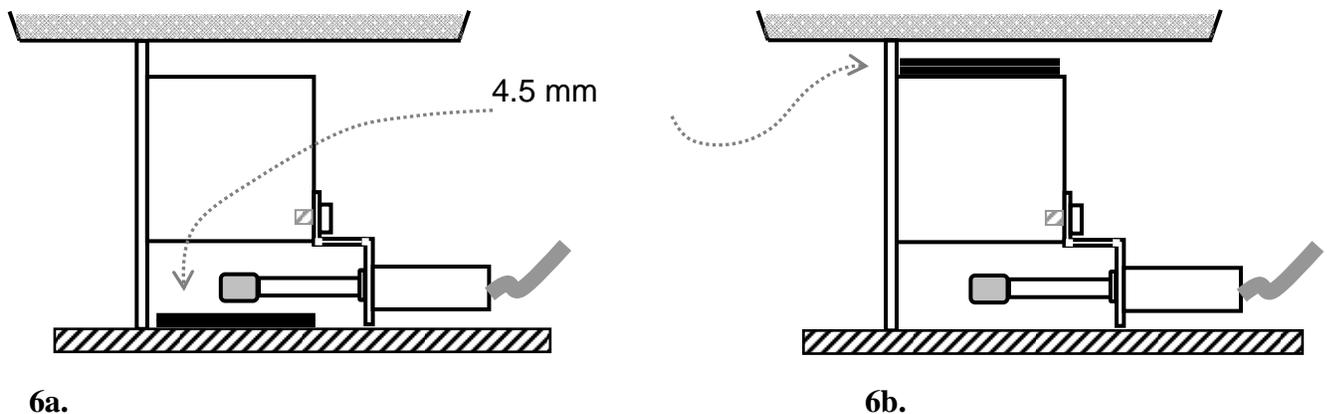
EXAMPLE:  $\frac{\text{mR/min}}{00303.0}$  with  $\frac{\text{mm AL}}{04.5}$

**3. Fixed Aluminum Method: HVL for ABC Units that CANNOT be Placed in Manual Mode**

The following procedure is to be used **ONLY** on those units that cannot be switched into the manual mode for HVL determination.

It is essential that a **fixed** amount of attenuating material remain in the beam between the x-ray tube and the ABC during all measurements. The **POSITION** of the aluminum filters in the beam will vary during the procedure but the **TOTAL** amount of aluminum in the beam will remain constant.

- a) With the phantom and the MDH probe properly positioned, adjust the size of the fluoroscopic beam until it is slightly larger than the sensitive volume of the MDH probe head.
- b) Set the MDH selector switch to the "**EXPOSURE RATE**" mode.
- c) Place 4.5 mm of aluminum on the table top directly beneath the MDH probe (figure 6a below). This places 4.5 mm of aluminum between the tube head and the MDH probe. Without making any changes in the standard patient techniques, make an exposure until the MDH reading stabilizes and note the exposure rate for 4.5 mm of aluminum.



**Figure 6.** Positioning 4.5 mm Aluminum for the HVL procedure, under-table units.

- d) Move the 4.5 mm of aluminum to the top of the phantom (figure 6b). Be sure that the aluminum is completely in the beam and is over the MDH probe. This places 4.5 mm of aluminum between the phantom and the

ABC. Make an exposure until the MDH reading stabilizes, and note the exposure rate for 0 mm of aluminum.

- e) If the exposure rate obtained in step 'd' above for 0 mm of aluminum is more than twice the reading obtained in step 'c' for 4.5 mm of aluminum, record the value obtained in step 'd' as the 0 mm of aluminum exposure rate and the value obtained in step 'c' as the 4.5 mm of aluminum value. This procedure ensures that 4.5 mm of aluminum is sufficient for determining the HVL. **Record the console kVp value in the HVL section of the data form. (kVp driven systems may change the kVp value from that used for the phantom only when the aluminum filters are added to the beam.)** Proceed with step g.

	<u>mR/min with 0 mm Al</u>	<u>mR/min with 4.5 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   0   1   2   1   .   0  </u>	<u>  0   0   0   4   5   .   8  </u>

- f) Do this step only if the step 'c' exposure rate value (4.5 mm of aluminum) is not less than 1/2 of the step 'd' exposure. Add more aluminum and repeat steps 'c' and 'd' above until you have sufficient aluminum to exceed the HVL. When you have added sufficient aluminum filtration, record the total amount of aluminum in boxes. Record the value obtained in step 'd' for the total aluminum as the 0 mm of aluminum exposure rate. Record the value obtained in step 'c' for the total aluminum exposure rate value. **Record the console kVp value in the HVL section of the data form. (kVp driven systems may change the kVp value from that used for the phantom only when the aluminum filters are added to the beam.)**
- g) Move 1.5 mm of aluminum from the top of the phantom and place on the table top beneath the MDH probe. This will place 1.5 mm of aluminum between the tube head and the MDH probe, leaving the remainder of the aluminum between the probe and the ABC. Make an exposure until the MDH reading stabilizes, and record the exposure rate (mR/min) for 1.5 mm of aluminum.

	<u>HVL kVp</u>	<u>mR/min with 1.5 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   9   0  </u>	<u>  0   0   0   9   2   .   5  </u>

- h) Move an additional 1 mm of aluminum from the top of the phantom to the table top beneath the MDH probe. This will place 2.5 mm of aluminum between the source and the MDH probe, leaving the remainder of the aluminum between the MDH probe and the ABC. Make an exposure until the MDH reading stabilizes, and record in mR/min the reading for 2.5 mm of aluminum.

- i) Move an additional 1mm of aluminum from the top of the phantom to the table top beneath the MDH probe. This will place 3.5 mm of aluminum between the tube head and the MDH probe, leaving the remainder of the aluminum between the probe and the ABC. Make an exposure until the MDH reading stabilizes, and record in mR/min the reading for 3.5 mm of aluminum.
- j) If only 4.5 mm of aluminum is used to determine the HVL, then leave the boxes for extra aluminum and its exposure value blank. If more is needed, indicate the amount (see step 'f' above).

**4. HVL Procedure for Over-Table Units**

**The unit must be in the manual mode with automatic brightness control (ABC) disabled for this method. NOTE: USE the same kVp used for the fluoroscopic exposure survey.**

- a) With the phantom and the MDH probe properly positioned (see figure 3), adjust the size of the fluoroscopic beam until it is slightly larger than the sensitive volume of the MDH probe head.
- b) Set the MDH selector switch to the "**EXPOSURE RATE**" mode.
- c) Without making any changes in the standard patient techniques, make an exposure until the MDH reading stabilizes. Adjust the mA to obtain an exposure rate of at least 1000 mR/min (1 R/min).
- d) **Record the kVp in the HVL section of the data form. THE EXPOSURE RATE** in mR/min as Exposure Rate for 0 mm of aluminum, e.g., 1.20 R/min is coded as 01200.0 mR/min and 12 R/min is coded as 12000.0 mR/min.

	<u>HVL kVp</u>	<u>mR/min with 0 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   9   0  </u>	<u>  0   1   2   1   0   .   0  </u>

- e) Secure (tape) 1.5 mm of aluminum to the collimator directly over the sensitive volume of the MDH probe (or place it on the support plate) and make a second exposure until the MDH reading stabilizes. Record the output in mR/min in the spaces provided for 1.5 mm of aluminum.

	<u>mR/min with 1.5 mm Al</u>
<u>EXAMPLE:</u>	<u>  0   0   9   2   5   .   0  </u>

- f) Secure (tape) an additional 1 mm of aluminum to the collimator directly over the sensitive volume of the MDH probe (or place it on the support plate). Make an exposure until the MDH reading stabilizes and record in mR/min the reading for 2.5 mm of aluminum.

mR/min with 2.5 mm Al

EXAMPLE: | 0 | 0 | 7 | 9 | 2 | . | 0 |

- g) Add an additional 1 mm of aluminum to the beam directly over the sensitive volume of the MDH probe. Take an exposure until the MDH reading stabilizes and record in mR/min the reading for 3.5 mm of aluminum.

mR/min with 3.5 mm Al

EXAMPLE: | 0 | 0 | 6 | 1 | 2 | . | 0 |

- h) Add an additional 1 mm of aluminum to the beam directly over the sensitive volume of the MDH probe. Take an exposure until the MDH reading stabilizes and record in mR/min the reading for 4.5 mm of aluminum.

mR/min with 4.5 mm Al

EXAMPLE: | 0 | 0 | 4 | 5 | 8 | . | 0 |

- i) This step need **only** be **performed** if the value obtained with 4.5 mm Al is not less than 1/2 the 0 mm Al value. Add as much Al filtration as you feel necessary to reduce the exposure rate to less than 1/2 the 0 mm Al value. Record the resulting exposure rate value and the total thickness of aluminum (in mm).

mR/min

XX mm AL

EXAMPLE: | 0 | 0 | 3 | 0 | 3 | . | 0 | with | 0 | 6 | . | 5 |

**G. IMAGING OF TEST TOOL & DETERMINING TARGET - TABLE TOP DISTANCE**

**1. Radiographic & Fluoroscopic High-/Low-Contrast for Under-Table Units**

- a) With the phantom properly positioned in the beam. **REMOVE THE MDH PROBE AND ALL ALUMINUM FILTERS.** Have the operator set up the unit with the standard patient techniques (for over-table units see below). Center the "Fluoro Test Tool" (figure 7) on the table top beneath the phantom. The engraved side of the test tool must be toward the phantom; the large aluminum disc should rest on the table top. Select the field size that was used for exposure measurements. Observe the fluoroscopic image and record the number of holes you can see on the inner ring and the number of screen meshes you can see on the outer ring.

	<u>NUMBER OF HOLES SEEN</u>	<u>NUMBER OF MESHES SEEN</u>
<u>EXAMPLE:</u>	<u>  4  </u>	<u>  3  </u>

- b) Next place a loaded cassette in the spot film device, set the format to **one-on-one** (1 on 1) and make a spot film exposure. Record the number of holes and screen meshes that can be seen on the developed radiograph. Note that there are separate answer spaces on the data form for fluoro & film score. You may also want to generate an additional film at this time for use in the darkroom fog test (see Section H).

	<u>NUMBER OF HOLES SEEN</u>	<u>NUMBER OF MESHES SEEN</u>
<u>EXAMPLE:</u>	<u>  4  </u>	<u>  3  </u>

**2. Determining Target-to-Table Top Distance for Under-Table Systems**

With the "Fluoro Test Tool" in place on the table top beneath the phantom (figure 7), measure, **in centimeters**, and record the distance from the center of the spot film cassette to the table top.

	<u>SPOT-FILM TO TABLE TOP DISTANCE (cm)</u>
<u>EXAMPLE:</u>	<u>  3   7   .   8  </u>

On the processed spot film, measure, **in centimeters**, and record the diameter of the image of the inner aluminum disc (figure 9). There will be two central rings close together on the radiograph. Measure the innermost one.

IMAGE DIAMETER (cm)

EXAMPLE:     |0|8| .|8|

Use the following equation to calculate the target-to- table top distance in centimeters and record the value in the boxes provided.

$$\text{Target-to-Table Top Distance} = \frac{4.4 \times \text{SD}}{\text{Diam} - 4.4} \text{ cm}$$

where: SD = Distance, in centimeters, from the center of the spot film cassette to the table top.

Diam = Diameter, in centimeters, of the image of the inner aluminum disk (inner most circle).

TARGET DISTANCE (cm)

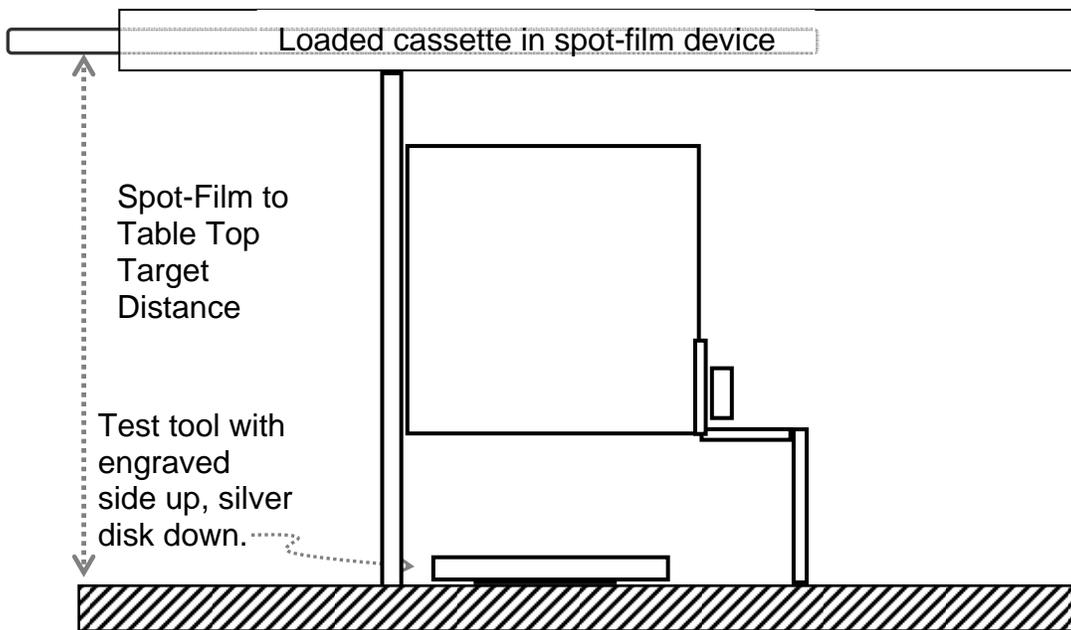
EXAMPLE     |3|7| .|8|

**3. Radiographic & Fluoroscopic High-/Low-Contrast for Over-Table Systems**

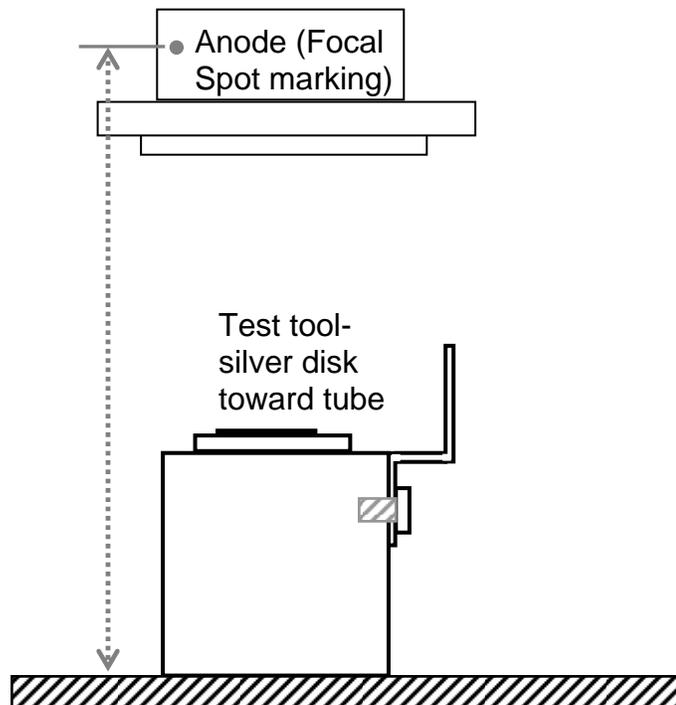
a) **REMOVE THE MDH PROBE.** With the phantom placed upside down on the table top (see figure 8) and properly centered in the beam, have the operator set up the unit with the standard patient techniques. Center the "Fluoro Test Tool" on the top of the phantom with the engraved side toward the phantom, i.e., the large aluminum disc side up facing the tube. Select the field size that was used for exposure measurements. Observe the fluoroscopic image and determine the number of holes you can see on the inner ring and the number of screen meshes you can see on the outer ring.

NUMBER OF HOLES SEEN     NUMBER OF MESHES SEEN

EXAMPLE:     |4|                     |3|



**Figure 7.** Set-up for fluoroscopic and radiographic high-/low-contrast procedure for under-table units.



**Figure 8.** Over-table units: Positioning of test tool and target-table top distance measurement.

- b) Next place a loaded cassette in the spot film device; set the format to **one-on-one** (1 on 1) and make a spot film exposure. Record the number of holes and screen meshes that can be seen on the developed radiograph. Note that there are separate answer spaces on the data form for fluoro & film score. You may also want to generate an additional film at this time for use in the darkroom fog test (see Section H).

	<u>NUMBER OF HOLES SEEN</u>	<u>NUMBER OF MESHES SEEN</u>
<u>EXAMPLE:</u>	<u>  4  </u>	<u>  3  </u>

Copper meshes per in	Contrast hole depths (in)
12	.0063
16	.0091
20	.0126
24	.018
30	.025
40	.035
50	.049
60	.068

**Outer diameter: 4 in.  
Diameter of silver disk: 2 in.**



**Figure 9. Fluoroscopic test tool—view of embedded test objects.**

#### **4. Target-to-Table Top-Distance Over-Table Units**

For over-table units, measure the distance from the anode to the table top and record the distance in centimeters as the target distance (figure 8). With the "Fluoro Test Tool" on the top of the phantom, place a loaded cassette in the spot film device, set the format to one-on-one (1 on 1), and make a spot film exposure. Leave the spot-to-table top distance and image diameter boxes blank for over-table units. **Return these films with your survey form.**

## H. PROCESSOR DATA

### 1. Processor Brand and Model/Chemistry Brand and Type

Determine from the operator the processor-chemistry combination used for the processing of the exposure films. Record the data on the lines provided and from Supplement Sections E and F determine the processor and chemistry codes, respectively, and enter them in the spaces provided. **If the PROCESSOR and/or CHEMISTRY codes are NOT on the list, write their COMPLETE NAMES, and the NAME, ADDRESS AND TELEPHONE NUMBER of the supplier in the comments section. If the chemistry is provided by a local supplier, then code the chemistry "IPCS XXX".**

	PROCESSOR BRAND <u>FUJI</u>	PROCESSOR MODEL <u>RU</u>
<u>EXAMPLE:</u>	<u>  F   U   J   P  </u>	<u>  R   U   -  </u>
	CHEMISTRY BRAND <u>FUJI</u>	CHEMISTRY TYPE <u>HIR</u>
<u>EXAMPLE:</u>	<u>  F   U   J   P  </u>	<u>  H   I   R  </u>

### 2. Sensitometric Test for the Evaluation of Processing

With the control film provided for the project and the darkroom/processor servicing the x-ray unit/tube surveyed, flash the control film (with the sensitometer) once, on all four sides. Process this film normally as film from the x-ray unit surveyed would be processed. Zero the calibrated densitometer and determine the optical density (OD) of the base (background) plus fog of the processed control film. Record in the space provided.

**NOTE: Wait at least 10 seconds between sensitometer flashes.**

	<u>BASE PLUS FOG</u>
<u>EXAMPLE:</u>	<u>  0   .   1   8  </u>

Determine the speed density by adding 1.00 to the optical density of the base (background) and fog. Record this optical density on the plotting work sheet.

Select the two steps that have optical densities above and below the speed density. (The step number is labeled on the film.) Read the optical density of each of these two steps twice (once on each of the two sensitometric strips on the film), record this optical density as well as the steps selected on the work sheet. **(If the**

**density difference between the same step on the 2 strips is greater than 0.2, repeat the test.)**

Average the measured densities for each step. Using the graph on the plotting and work sheet form, plot the step number and the average optical density. Connect these two points with a straight line.

For the optical density of the base-plus-fog plus one, interpolate a sensitometer step number or "speed step." Using this "speed step" and the associated table, determine the processor speed. Record this on the survey form under processor speed index.

If the processor speed index is not between 80 and 120, it is strongly recommended that the test be repeated. Start with a fresh control film and repeat the sensitometric exposure (part 4 above) before proceeding with the speed index calculation.

PROCESSING SPEED INDEX

EXAMPLE:            | 1 | 0 | 1 |

**NOTE : Label and send this film with the completed survey form.**

**3. Darkroom Fog Measurement**

The following procedure is to be used to measure the darkroom fog level. A darkroom fog test tool has been provided for this measurement and should be used whenever possible.

**NOTE: USE FACILITY'S FILM FOR THIS TEST**

Make a radiograph of the phantom using a cassette loaded with the facility's film (the radiograph made previously for image evaluation is NOT to be used for this test). You can select the techniques that were used for the spot film exposure measurements. This will provide a test film with a uniform optical density, rather than the range of densities obtained using the Step-Wedge Method.

In the darkroom, remove the film from the cassette and insert the film into the darkroom fog folder (or cover one half of the film with a piece of cardboard). The longest side of the film should be inserted into the fog folder to ensure that you are approximately bisecting the latent image. (This will be true if you center the phantom in the x-ray beam before making the exposure.)

Position the film and folder in an area of the darkroom, usually on the workbench, closest to a safelight. This should represent, in your opinion, an area where film

is routinely handled and has the highest probably of safelight exposure. Expose the uncovered half of the film to normal safelight conditions for two minutes. Make sure that you are not accidentally shielding the film from other potential fog sources such as safelights or digital light sources. After two minutes have elapsed, quickly remove the film from the folder, and process normally.

If a visible border, corresponding to the edge of the mask (and the letters "**FOG**" if using the FDA folder) appears on the film, then you have a fogging problem. Fog levels with a difference of less than 0.10 density units between the fogged and unfogged part of the film may be considered satisfactory for normal film handling times. Fog levels in excess of 0.1 can usually be reduced with minimal effort. Record the film fog level in the boxes provided.

	FILM DENSITY w/o FOG	FILM DENSITY w/ FOG	DARKROOM FOG LEVEL
<u>EXAMPLE:</u>	<u>  1   .   1   8  </u>	<u>  1   .   3   5  </u>	<u>  0   .   1   7  </u>

**END OF SURVEY PROTOCOL**

# 2003 NEXT Fluoroscopic Survey

## Facility Questionnaire

Thank you for completing this questionnaire. The items below seek information about your facility's diagnostic radiology program. The emphasis of this survey is on equipment used to perform upper G.I. fluoroscopic x-ray exams , but there are also questions covering other aspects of your department. It may be necessary for several persons such as the medical physicist and the QC technologist to contribute to the responses, and *it may wish to review your department records in order to complete this form* . Your reasonable estimates are sufficient for the purposes of this survey. If you have questions about this form you may contact the NEXT surveyor for answers and clarification.

*Please return the completed form to the NEXT surveyor as soon as possible.*

*This section to be completed by surveyor*

Surveyor Name	<input type="text"/>	State	<input type="text"/>
Phone	<input type="text"/>	Fax	<input type="text"/>
Address	<input type="text"/>		
Facility Name	<input type="text"/>	Survey Date	<input type="text"/>

*Facility personnel: please begin here:*

### Facility Information

1) Facility person(s) completing this form

a) Name	<input type="text"/>	Title	<input type="text"/>
b) Name	<input type="text"/>	Title	<input type="text"/>
c) Name	<input type="text"/>	Title	<input type="text"/>

2) Number of department staff members : Please enter in the spaces below the number of persons who are :

Radiographic Technologists	<input type="text"/>
Radiologists	<input type="text"/>
Medical Physicists ON STAFF	<input type="text"/>
Medical Physicists BY CONTRACT	<input type="text"/>

3) Diagnostic Imaging Procedures done at your facility. Please estimate the approximate number per month for each procedure indicated.

	Patient Workload - number/ month
General Radiographic Exams (excluding portables)	<input type="text"/>
Portable radiographic exams	<input type="text"/>
Fluoroscopy (general purpose such as GI)	<input type="text"/>
Special fluoroscopic procedures (cardiac, etc)	<input type="text"/>
Mammography (screening only)	<input type="text"/>
Mammography diagnostics (interventional)	<input type="text"/>
Magnetic resonance imaging (MRI)	<input type="text"/>
Computed tomography (CT)	<input type="text"/>
Ultrasound	<input type="text"/>
Dental radiography	<input type="text"/>
Mobile radiographic services	<input type="text"/>
Nuclear medicine imaging	<input type="text"/>
Bone densitometry	<input type="text"/>

4) The following questions concern your department's position with respect to upper gastro-intestinal fluoroscopy. **NOTE:** These questions refer only to equipment used at your facility for performing upper G.I. exams. Do not consider special procedures fluoro suites used for cardiac imaging or other interventional procedures which may use digital technology when you respond to this question.

(Enter A, B, C, or D) :

- A We currently do not use digital imaging for upper G.I. fluoro and do not plan to purchase/convert to digital in the near future.
- B We currently do not use digital imaging for upper G.I. fluoro but we will likely purchase/convert within the next two years.
- C We currently utilize both digital and film based imaging systems for upper G.I. fluoroscopy.
- D We currently use digital imaging for all of our upper G.I. fluoroscopy procedures.

**X-Ray Equipment Information**

5) How many of the following types of fluoroscopic x-ray systems does your facility have?

General purpose radiographic/ fluoroscopic units	<input type="text"/>
Dedicated angiographic room	<input type="text"/>
Dedicated electrophysiology room	<input type="text"/>
General interventional procedures (eg: cardiac or extremity cath lab)	<input type="text"/>
Mobile C-arm systems (eg: for orthopaedics)	<input type="text"/>

**Medical Physicist Survey**

6) For **the specific x-ray unit that the NEXT surveyor will work with**, how often does it undergo a physics survey? Please respond with **W**(weekly), **M**(monthly), **Q**(quarterly), **A**(annually), **S**(semi-annually), **N**(never), **R**(as required), or **K**(don't know)

\_\_\_\_\_

7) Please indicate with an 'X' whether each of the following tests is performed during the physics survey.

fluoroscopic collimation	_____	estimate of patient exposure/ dose	_____
spot film collimation	_____	exposure rate for high dose mode	_____
kVp accuracy	_____	fluoroscopic contrast resolution	_____
x-ray beam quality(HVL)	_____	fluoroscopic spatial resolution	_____
Spot Film AEC performance	_____	Image Intensifier Input exposure rate	_____
Tube output: mR/mAs	_____	softcopy imaging monitor QC	_____
Tube output linearity	_____		
Tube output reproducibility	_____		

**Specific Questions for Facilities Performing Interventional Procedures**

8) Does the facility have a fluoroscopy user credentialing program? \_\_\_\_\_  
 Is this program completed in-house or under contract? \_\_\_\_\_

9) Is there a patient dose monitoring program in place? \_\_\_\_\_

Briefly describe this program and which procedures are included \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

10) If the JCAHO should incorporate fluoroscopically induced skin injuries into its Sentinel Event program, does the facility have a policy and procedure in place to conduct a causal analysis of this type of event? \_\_\_\_\_

11) Does the patient consent form used by the facility for interventional procedures address radiation exposure and potential skin injuries? \_\_\_\_\_

12) Is it standard procedure to question patients regarding their history of medical imaging exposure? \_\_\_\_\_

13) Does the facility conduct any follow up on patients relating to possible radiation induced injuries which could result from fluoroscopic procedures? \_\_\_\_\_

14) What field size is most typically used when fluoroscopy is employed during interventional procedures? \_\_\_\_\_ IN / CM